PB87-129730

Ambient Air/Source Transport and Transformation Relationships for Selected Hazardous Air Pollutants

Global Geochemistry Corp., Canoga Park, CA

Prepared for

Environmental Protection Agency
Research Triangle Park, NC

Nov 86

U.S. Department of Commerce
National Technical Information Service
NTIS

PB87-129730

EPA/600/3-86/063
November 1986

AMBIENT AIR/SOURCE TRANSPORT AND TRANSFORMATION RELATIONSHIPS FOR SELECTED HAZARDOUS AIR POLLUTANTS

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SPRINGFIELD, VA. 22161

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO.
EPA/600/3-86/063

2.

3. RECIPIENT'S ACCESSION NO.
PB87 129730/AS

4. TITLE AND SUBTITLE
AMBIENT AIR/SOURCE TRANSPORT AND TRANSFORMATION RELATIONSHIPS FOR SELECTED HAZARDOUS AIR POLLUTANTS

5. REPORT DATE
November 1986

6. PERFORMING ORGANIZATION CODE

7. AUTHOR(S)
R. L. Bremer, R. J. Gordon, C. C. Lin, R. J. Countess, T. J. Peters and J. D. Walsh

8. PERFORMING ORGANIZATION REPORT NO.

9. PERFORMING ORGANIZATION NAME AND ADDRESS
Global Geochemistry Corporation
6919 Eton Avenue
Canoga Park, California 91303

10. PROGRAM ELEMENT NO.
C9TA1B:01-2025 (FY-86)

11. CONTRACT/GRANT NO.
68-02-3761

12. SPONSORING AGENCY NAME AND ADDRESS
Atmospheric Sciences Research Laboratory-RTP, NC
Office of Research and Development
U. S. Environmental Protection Agency
Research Triangle Park, North Carolina 27711

13. TYPE OF REPORT AND PERIOD COVERED

14. SPONSORING AGENCY CODE
EPA/600/09

15. SUPPLEMENTARY NOTES

16. ABSTRACT

The study was undertaken with the goal of obtaining information that could improve modeling technique for hazardous organic vapors in the atmosphere. It was proposed that both source-receptor and dispersion models be applied. Detailed examination of alternative choices for pollutant emission site and method of determination was made. The benzene class as pollutants, a waste disposal site near Taft, California (in the San Joaquin Valley) as source, and Tenax adsorption from the air, followed by thermal desorption and gas chromatography as method of determination, were selected. A combination of poor meteorological conditions, inadequate sample collection and contribution from other unidentified organic source prevented the determination of suitable modeling determination. Conclusions and recommendation for future sampling studies are included.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Dis.		

18. DISTRIBUTION STATEMENT
RELEASE TO PUBLIC

19. SECURITY CLASS (This Report)
UNCLASSIFIED

20. SECURITY CLASS (This page)
UNCLASSIFIED

21. NO. OF PAGES
309

22. PRICE

EPA Form 2220-1 (9-73)

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ABSTRACT

This study was undertaken with the goal of obtaining information that could improve modelling techniques for hazardous organic vapors in the atmosphere. It was proposed that both source-receptor and dispersion models be applied. Detailed examination of alternative choices for pollutant, emission site and method of determination was made. The benzene class as pollutants, a waste disposal site near Taft (in the San Joaquin Valley of California) as source, and Tenax adsorption from the air, followed by thermal desorption and gas chromatography as method of determination, were selected. Cleanup procedures for Tenax were developed that allowed generally quite good agreement with ASRL measurements on reference mixtures supplied in canisters by ASRL. Co-located canisters and Tenax tubes were sometimes in agreement and sometimes not (even allowing for the dissimilarity of the procedures). This may be due in part to interferences in the Tenax (packed column) GC that are resolved in the EPA canister (capillary column) GC method.

Collections on Tenax were made on several occasions in 1985 and 1986 by means of a remotely controlled system of samplers (developed in this project), supplemented by canisters supplied by ASRL and used with manually controlled pumps. Poor meteorological conditions and a sampling array found to be too small prevented obtaining satisfactory data for modelling purposes in 1985. A modest expansion in the size of the sampling array was made and utilized with further collections during May, 1986. This data was of higher quality in terms of meteorology and chemical species information, but it revealed substantial emissions from unknown sources of the study compounds. Various attempts were made to apply Gaussian and receptor model techniques to these data, without success. The conclusions are that the study source was not sufficiently isolated from other sources in the area to allow for such modeling studies.

Recommendations for improvements in future work of this type are given.

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ACKNOWLEDGMENT

The Project Officer, William Lonneman of the Atmospheric Sciences Research Laboratory of EPA, has been a helpful guide and technical advisor. Sandra Lamb (now at the UCLA Department of Chemistry) provided the computerized data base searches. Richard Brewer of GGC and William Ryan of ES assisted in the field studies.

SECTION 1

INTRODUCTION

Atmospheric modelling of volatile substances is usually done from the source forward, by means of dispersion models. If the concentration of pollutants of interest decreases by means additional to dispersion, the modelling predictions of course are inaccurate. There is much current interest, moreover, in source-receptor modelling, whereby the ambient air composition is related to specific sources or source types by means of its composition. This is particularly useful for certain hazardous substances that are not found in the atmosphere except through emissions from specific sources. Also fingerprint compositions identified at specific sources are useful for this type of modelling. The study was undertaken with the aim of carrying out air sample collections of one or more hazardous substances in such a way as to be applicable to both types of modelling.

The hazardous pollutant or pollutant group was selected from the list in Section 112 of NESHAPS or "Chemicals Under Assessment" (as of 1983). Ten of these with very low volatility, or without well-defined chemical composition, were deleted. Ten others were added in the process of selection, making a total for consideration of 48.

Phase I included the selection of pollutants to be studied, the selection of the study site, and the selection of the sampling and analytical methodology. Phase II included the actual sampling, analysis, and data interpretation. Engineering Science (ES) participated as subcontractor in both phases; in site selection and development of sampling strategy in Phase I, and in meteorological forecasts and measurements as well as data interpretation in Phase II. The Atmospheric Sciences and Research Laboratory (ASRL) of the U.S.Environmental Protection Agency (EPA) at Research Triangle Park (RTP), North Carolina (NC), participated by providing standard reference gas mixtures, loans of canisters and pumps for parallel gas sample collection, and independent analyses of canister samples for quality assurance purposes. The latter ASRL analyses were made with capillary gas chromatography and provided a very detailed hydrocarbon breakdown for the canister samples.

This report describes both Phases and discusses the results. Certain recommendations are made for further work.

SECTION 2

SUMMARY AND CONCLUSIONS

SELECTION OF POLLUTANTS FOR STUDY

The list of 48 hazardous organic pollutants suggested for study in the original EPA solicitation included ten substances that were either of very low volatility or constituted complex mixtures not suitable for the purposes of the project, such as inorganics, or coke oven emissions. These were deleted, but the list was augmented by ten additional toxic or halogenated compounds. This was screened on the criteria of usage or occurrence in California, emission potential, volatility, and observed ambient concentrations at landfills. The additional criteria of estimated ambient half-life (based on reaction rates with the OH radical), and estimated toxicity or carcinogenicity, were also considered. A further requirement was a suitable methodology for collection and analysis. Complex mixtures of isomers and homologs or functional classes were eliminated, along with substances that commonly occur as products of general atmospheric photochemical reactions. The remaining compounds with the highest ratings fell substantially into two classes: volatile halogenated hydrocarbons and volatile benzenoid hydrocarbons. The final selection for the benzene group: benzene, toluene, and o-, m- and p-xylenes, was based partly on the site characteristics, and is discussed in the next section.

Determination of the specific potential pollutants to be considered for this study indicated that our first expectations of following the concentration decreases of pollutants caused by processes such as photochemical reaction were somewhat unrealistic. Despite relatively concentrated source emissions, dilution by atmospheric processes resulted in ambient levels near the limits of analytical detection no more than one or two kilometers downwind from most of the areas considered. The time for this transport (not likely to be over 20 minutes during any satisfactory sampling conditions) is too brief for chemical reaction to have had much effect, even with quite reactive compounds.

SITE SELECTION

An early decision was made to confine the study to the California area, because of the greatly increased cost of sampling elsewhere in the country, and the risk of deterioration of samples during shipping of samples longer distances back to the GGC laboratory. A review was made of the chemical industry in the state. State and local air pollution agencies were contacted for information and advice. The many chemical plants in central and southern California are subject to stringent air pollution control measures and generally do not emit sufficient concentrations of hazardous pollutants on a reliable basis. The use of a landfill source appeared more promising; moreover there was interest on the part of both EPA and local agencies in information concerning landfill emissions. The characteristics of active landfills in the state were examined. After eliminating those with unsuitable terrain and those for which the status was changing, a class II-1 landfill able to accept all but the most toxic wastes was selected. The site was located in the southern San Joaquin Valley within a hundred miles of the GGC laboratory. This facility has good terrain and, based on historical records, suitable meteorological conditions. Arrangements were made to go onsite and to have access to records of waste received. Small-scale pilot trials indicated the site released suitable organic compound levels for sampling. The site was selected and used for sample collection. A change in ownership caused considerable delays in the first part of 1985.

SAMPLING PLAN AND OPERATIONS

The project subcontractor, Engineering Science, advised on the meteorological conditions required and the sampling layout needed for the modelling studies. Both source-receptor and Gaussian dispersion models were to be utilized. Consequently, it was intended that data collection serve both purposes. It included a downwind array of samplers, along with one or two immediately at the source ponds, and one upwind. The total of ten samplers was deployed in the 1985 studies, using a remote control radio network switching system developed for the project. The dimensions of the array were adjusted according to the windspeed and estimated atmospheric stability class for adequate coverage of assumed Gaussian dispersion. This network was increased to sixteen samplers for studies made in 1986.

Sampling efforts were performed on July 9-11 and September 4-5, 1985, based on favorable meterological forecasts. However, on both occasions the winds were quite variable over the planned periods. Good conditions were experienced for only one sampling period. None of the data sets obtained from these runs was adequate for receptor modelling purposes. After augmenting the number of samplers from twelve to sixteen, and obtaining an integrating anemometer, additional runs were made on May 20-25 in 1986. The wind conditions were favorable on most of these runs.

During all three sampling episodes, canisters obtained from ASRL were used for parallel sampling. These canisters were used both at co-located and independent sites. After sample aliquots were taken for analysis by GGC, the canisters were sent to RTP for more detailed analyses by capillary GC. These samples served both for QC comparison and as a means of characterizing the landfill emissions. Despite nearly continuous monitoring of meteorological conditions, very limited opportunities occurred in the fall and winter of 1985-86 for additional sampling at the site. The weather conditions improved greatly by May of 1986.

TENAX TUBE PREPARATION AND ANALYSES

Procedures for cleaning and using Tenax adsorbent tubes were undergoing study at EPA and elsewhere during Phase I of the project. Early project difficulties in cleaning and storing the Tenax tubes were overcome at GGC, at least for purposes of the analysis of benzene and its homologs, by a process of oven purging, and then sealing the glass tubes for storage before and after sampling. GC analysis by thermal desorption of Tenax tubes used to sample canisters of reference mixtures agreed well with the EPA analyses and the known concentration. Blanks and replicate samples showed low background levels and good reproducibility. The use of a photoionization detector permitted highly specific sensitivity for the benzene group despite the presence of large amounts of other hydrocarbons shown by ASRL's capillary GC-FID analyses of the same canister samples. There were at times large discrepancies between the analyses of field samples in canisters and the co-located Tenax tubes. These discrepancies were probably usually due to sampling rather than analytical differences. At times however, large amounts of interfering compounds co-eluted with the benzene class compounds.

ASSESSMENT OF DATA

Field sampling was performed on several occasions during July and September, 1985 at the Taft site. In essentially all test runs, the winds were highly variable during the sampling period and prevented identification of plume dimensions and atmospheric stability. Additionally the highly variable atmospheric conditions which prevailed during sampling appeared in retrospect to have made the sampler numbers and placement less than optimal. Sample locations were either inadequate in downwind and crosswind directions, or were inadequate in total number to provide a clear picture of plume behavior from the waste ponds. Although there was a consistency in sampling results, there was insufficient data available at this time from which to draw any but the most general conclusions. Overall, the limited quantity and somewhat inconsistent nature of the 1985 sampling results did not support either receptor or Gaussian dispersion models.

During the 1986 field trials, additional samplers provided better area sampling coverage, and the use of an electronic integrating anemometer eliminated much of the data ambiguity in meteorological parameters experienced during the initial 1985 tests. However, attempts to relate sampling results to either a source term at the waste ponds or atmospheric dispersion behavior were inconclusive. No clear sense could be made of the field data in spite of a variety of analytical approaches. While data were usually internally consistent regarding relationship between hydrocarbon species concentrations, there was no apparent relationship between measured concentrations and wind speed, direction, and atmospheric stability. At times in the downwind sampling grid winds coming from ca 270° to 180° degrees yielded grid concentrations in the same range as those measured with a 360° wind direction that directly traversed the waste ponds. Furthermore, concentrations varied appreciably from sample run to sample run, often being an order of magnitude or more different from one time to the next.

The latter two results seem to indicate rather strongly that field sampling data were not related entirely to emissions from the waste ponds but were at least partly related to other unidentified sources. There are oil field drilling and pumping activities in the surrounding area to the Taft site (say within several kilometers). Sampling data show an apparent interference by these other sources preventing the determination of a consistent pattern that could be linked to the waste ponds.

A number of the 1986 sampling runs reveal a more frequent incidence of peak concentrations located in the eastern half of the sampling grid (see Section 6). These peaks vary somewhat in specific location and magnitude; however the frequency of occurrence over the sampling series suggests the possibility of one of the waste ponds in the eastern part of the source area being more active in emissions than those further west. It has not been possible to quantify this effect, primarily because of the very strong background levels of the hydrocarbon species sampled.

In general, despite a variety of approaches to fit sampling data to Gaussian or receptor modeling techniques, it was concluded that emissions from other unknown sources in the general area of the Taft site contribute overwhelmingly to samples, thus masking any delineation of hydrocarbon species from the waste ponds. The high levels of sampled species during episodes with winds other than those from the ponds to the sample grid leads to this conclusion. The ultimate conclusion is that it is not possible to relate receptor modeling (or Gaussian modeling) to the field data collected at the Taft site.

Due to the addition of canisters provided and later analyzed by ASRL, RTP, NC, it was possible to compare the Tenax/PID-GC data with the much more complete capillary GC/FID data. These comparisons were performed both for co-located canister/tube pairs and for standard mixtures in stainless steel canisters prepared and analyzed by ASRL. In the latter case, aliquots of these standard mixtures were collected on Tenax tubes and analyzed by PID-GC. Although canister/tube comparisons for reference mixtures were good, the co-located pairs from the field did not agree in many cases. In this case Tenax values were often higher, and may have reflected the presence of large amounts of co-eluting non-aromatic components; although the PID is highly selective for aromatics compared to saturated hydrocarbons, large amounts of the latter may still give enough response to constitute a serious interference.

A further striking finding from the canisters was the large number of compounds and the high concentrations present in many of the samples. The total non-methane hydrocarbons in canisters were as high as 9.5 ppm carbon. Of these the target aromatic hydrocarbons comprised only a few percent. Moreover the detailed GC results indicated that there were numerous compounds at moderate concentrations.

The observed inconsistent air distribution patterns made the modeling impossible to carry out. The conclusion is that this type of source or source area having such a large number of individual chemical species at fairly high concentrations is not desirable for use in modeling studies.

SECTION 3

RECOMMENDATIONS

RECOMMENDATIONS FOR IMPROVEMENT IN SITE SELECTION

1. A complex composition of organic compounds was observed at the landfill site in Taft, California. The concentration levels of the selected C_6 to C_8 benzene compounds were not sufficient to observe losses due to chemical transformation. In future studies the modelling efforts would be better served by the selection of a site with less complex composition and larger emission rates. If source compositions were not sufficiently distinguishable from other sources, the use of unique tracers should be considered.

RECOMMENDATIONS FOR IMPROVEMENTS IN SAMPLING

1. The use of an integrating anemometer, including a digital data logger and averaging program, greatly facilitated meteorological data reduction and interpretation. It eliminated much of the ambiguity present in reading and interpreting analog information collected during each sampling run. Its use is highly recommended over a simple analog stripchart instrument.

2. Although no tangible results were obtained during this project regarding Gaussian and receptor modeling and the relationships of pollutant travel time with pollutant transformations, it appears that a more extensive sampling grid (in the downwind direction) might be required in order to quantify pollutant reactivity. In the field tests run under this program, travel time from the waste ponds to the furthest receptor point downwind varied from 76s to as much as 478s. However atmospheric half-lives of the common hydrocarbon species are more apt to be in the range of minutes to hours. Thus it appears that samplers located several kilometers downwind might be required to quantify substance reactivity in actual field conditions. This was considered for the Taft site but was impractical due to the limited radio range of the samplers and lack of unobstructed downwind siting area at such distances.

3. Variations in ground heating or some other external factors can have a significant effect on plume shape. One or two samplers should be mounted on 5 to 10 meter poles along the approximate downwind centerline to determine the dimensions of the plume. This would permit a more definitive vertical profile of the plume, and a better grasp on atmospheric conditions through a fit of vertical dispersion (sigma-z) parameters.

RECOMMENDATIONS FOR IMPROVEMENTS IN MODELLING

1. Highly variable wind direction traces are commonly experienced during periods when photochemical reactivity rates may be expected to be at a maximum (clear, warm days with high

solar insolation). These recorded wind direction traces do not permit a clear definition of atmospheric stability for modified Gaussian model application to sampling results. Use of vertical temperature profiles or sigma-theta to define stability would permit significantly improved model application to sampling results.

2. The location of the waste disposal site at Taft, California in the midst of an active, producing oil field region was a major factor in the lack of concrete results from this program. The benzene compounds are common components of these source types. From examination of the meteorological and sampling data, it appears that fugitive emission from many other unknown activities around the test site were of sufficient magnitude frequently to overwhelm and obscure any data on materials which may have been emitted from the waste ponds. The selected species are apparently present in abundance as fugitive emissions of hydrocarbon volatiles from well pumping, tank loading and unloading, or other normal oil field activities. Future sites for receptor model field tests should be selected based on a clear absence of such external sources of the materials for which sampling is contemplated. The prospective sampling site should be effectively isolated from contamination by other nearby sources so that samples of specific substances may be unambiguously attributed to a unique and identificable source. This is an ideal that will seldom be achieved absolutely, but should be the goal.

3. Even if the background interferences actually had not included the specific compounds to be used for the study, the presence of the multitude of other substances, as in this case, made the analytical data based on photoionization detection and packed column GC less precise. This suggests that a capillary GC methodology would be preferable because for studies of waste disposal sources its superior resolution would minimize interferences. Also, for complex mixtures it might allow the use of fingerprint chromatograms to characterize source emissions.

4. The Tenax adsorptive cartridges provided a simple and convenient method of sampling. They are lightweight, can be operated with small battery-operated personnel sampling pumps, and are inexpensive. With proper testing and evaluation this sampling device can be successfully used for simple mixtures. Nevertheless, for complex mixtures of the type found in this study, the canisters offer advantages that were greater than were appreciated at the outset. One of these is the opportunity to repeat the analytical determinations or to have audit runs made on the same canister, whereas with a cartridge, there is only one chance for an analysis. Although use of canisters with their larger pumps would increase costs considerably, these factors should be considered for complicated mixtures such as emissions from waste disposal sites.

SECTION 4

PHASE I: SELECTION OF POLLUTANT, METHODS, AND SITE

INFORMATION SOURCES

Prior to this work and during the course of it, more than forty individuals, agencies, or companies were contacted for information or advice. Several EPA branches concerned either with hazardous wastes or analytical methodology, along with several individuals in Region IX, were consulted. The California Air Resources Board (CARB), the South Coast Air Quality Management District (SCAQMD), Ventura County, Santa Barbara County, and the Southern California Hazardous Materials Task Force were also contacted, including several individuals in the first two agencies. We also made contact with a number of landfill or waste management companies. Several private laboratories were queried on analytical procedures. Computerized data bases were consulted extensively, particularly for information on chemical and toxicological properties.

SELECTION OF HAZARDOUS AIR POLLUTANTS FOR STUDY

Initial Candidate Pollutant Listings

The hazardous pollutants of interest to EPA are shown in Table 1. They include two from Section 112 of NESHAPS, 36 from "Chemicals Under Assessment" (as of 1983), five more added because of their known toxicity, and five chlorinated compounds because they commonly occur along with others in their class on the list.

The original lists of compounds included certain inorganic compounds of low volatility, asbestos, and radionuclides. These were eliminated from further consideration since they would not be detected in the gas phase during the field study phase of this program. "Coke oven emissions" were also deleted since it was felt that this definition was too vague for our purposes. The remaining 48 substances (including the ten that were added) were reviewed for selected chemical, physical, and toxicity properties: melting point, boiling point, vapor pressure, vapor density, Henry's law constant, photochemical reactivity (toward OH radical), and toxicity rating. The following additional information was also compiled:

- EPA recommended analytical techniques
- SAROAD number, if available
- Chemical Abstracts Registry number (CAS)
- Toxicological data from MEGS (Multimedia Environmental Goals for Environmental Assessment Study) and/or

TABLE 1. INITIAL LIST OF HAZARDOUS AIR POLLUTANTS
(From EPA "Chemicals Under Assessment, 1983" Except As Noted)

acetaldehyde
acrolein
acrylonitrile
allyl chloride
aniline*
benzene**
benzyl chloride
bis-chloromethyl ether*
carbon tetrachloride
chlorobenzene
chloroform
chloroprene
o-,m-,p-cresol
p-dichlorobenzene
1,1-dichloroethane*
1,2-dichloroethylene*
dimethylnitrosamine
dioxane*
dioxin
epichlorohydrin
ethylene dibromide*
ethylene dichloride
ethylene oxide
formaldehyde
hexachloropentadiene
hexachloroethane*
maleic anhydride
methyl chloride*
methyl chloroform
methylene chloride
nitrobenzene
nitrosomorpholine
perchloroethylene
phenol
phosgene
polychlorinated biphenyls
propylene oxide
toluene
toluidine*
trichloroethylene*
1,1,2-trichloroethane
vinyl chloride**
vinylidene chloride
o-,m-,p-xylene

* added to the list of chemicals under assessment
** listed under Section 112

TDB (Toxicology Data Bank of the National Library of Medicine), with updates on 23 of the compounds from a National Cancer Institute Report (No. 1-CP-95607, March 1982).

A detailed summary of this data is included in Appendix B.

Evaluation of Candidate Pollutants

The following available data were compiled for use in evaluation of the 48 pollutants of interest:

- ambient airborne concentrations at urban, rural and landfill sites (Table 2)
- emissions data from the South Coast and Sacramento Air Quality Management Districts (Table 3)
- reaction rate constants with atmospheric levels of OH

TABLE 2. AVERAGE AMBIENT AIRBORNE CONCENTRATIONS

Compound	Concentration (ppb)		
	Urban Sites[a]	Rural sites[b]	Landfills[c]
Acetaldehyde		0.3	
Acrolein			
Acrylonitrile			
Allyl chloride			
Aniline			
Benzene	2-14, 0.1-37	0.01-1.5	4
Benzyl chloride	0.02		*
Carbon tetrachloride	0.2, 0.1-3	<0.1	*
Chlorobenzene	0.15, 0.01-3		*
Chloroform	0.08, 0.01-5	<0.01	0.5
Chloromethyl ether			
Chloroprene			
Cresol			
p-Dichlorobenzene	0.05, 0.01-0.2		*
1,1-Dichloroethane	0.07, 0.001-0.2		*
1,2-Dichloroethylene	0.06, 0.02-0.6		*
1,4-Dioxane	0.01		*
Dioxin			
Epichlorohydrin			
Ethylene dibromide	0.02-1		
Ethylene dichloride	0.5-4, 0.01-3		1.2
Ethylene oxide			
Ethylene trichloride	0.5, 0.005-3	<0.03	1.5
Formaldehyde	10-30, 6-41		
Hexachlorocyclopentadiene			
Hexachloroethane			
Maleic anhydride			
Methyl chloride	1.0, 0.4-2	<0.6	
Methyl chloroform	0.7, 0.1-3	<0.1	1
Methylene chloride	1.0, 0.05-9	<0.01	*
Nitrobenzene	<0.1		
Nitrosodimethylamine	<0.1		

(cont.)

TABLE 2. (cont.)

Nitrosomorpholine			
PCB	<0.001		
Perchloroethylene	1.0, 0.01-8	<0.1	2
Phenol	<1		
Phosgene	0.05, <0.02		
Propylene oxide			
Toluene	5-40, 0.1-65	0.4-2.6	*
o-Toluidine			
1,1,2-Trichloroethane	0.01, 0.001-1.0		*
Vinyl chloride	<0.1-2	<0.005	4
Vinylidene chloride	0.35, 0.001-0.2	<0.005	*
Xylenes	2-30, 0.1-23	0.1-0.6	*

a. JAPCA 33: 1177 (1983); ERT Report P-A764-500, Nov. 83; Atmos. Env. 15: 601 (1981); Atmos. Env. 12: 2383 (1978); range denotes wide variation for various urban sites.

b. H.B. Singh et al. EPA600/S3-83-002, March 1983.

c. JAPCA 33: 328 (1983); ES&T 9: 1042 (1975).

d. SCAQMD Report, El Monte, CA., 1983; asterisk (*) denotes compound observed but not quantified in USC Report to CARB, Feb. 1982.

TABLE 3. EMISSIONS OF HAPS IN SCAQMD AND SACRAMENTO AQMD

Compound	SCAQMD Emissions (tons/year) Reference 1[a]	Sacramento AQMD Emissions (tons/year) Reference 2[b]	Sacramento AQMD Emissions (tons/year) Reference 3[c]	Major Sources in SCAQMD
Acetaldehyde				
Acrolein				
Acrylonitrile	2			
Ally chloride				
Aniline				
Benzene	16,790	3,378	1840	Gasoline engines(96%)
Benzyl chloride				
Carbon tetrachloride	7			Solvent use(57%) Fluorocarbons(43%)
Chlorobenzene				
Chloroform	Trace			
Chloromethyl ether				
Chloroprene				
Cresol				
p-Dichlorobenzene				
1,1-Dichloroethane				
1,2-Dichloroethylene				Landfills
1,4-Dioxane	3.3			Degreasing
Dioxin	0			
Epichlorohydrin	0.1			
Ethylene dibromide	1.3			
Ethylene dichloride	13.5			
Ethylene oxide	378			Sterilization(81%); Fugitive losses(13%)

(CONT.)

TABLE 3. (CONT.)

Ethylene trichloride	807		36	Degreasing(92%)
Formaldehyde	176,777	2,426	1380	Photooxidation(96%); Combustion(4%)
Hexachlorocyclopentadiene				
Hexachloroethane				
Maleic anhydride	3.6			
Methyl chloride				
Methyl chloroform	18,424	2,595	480	Degreasing(77%); Adhesives/ Aerosols(15%)
Methylene chloride	12,938		370	Degreasing(44%); Solvent Use/ Aerosols(50%)
Nitrobenzene				
Nitrosodimethylamine				
Nitrosomorpholine				
PCB	<0.1			
Perchloroethylene	13,693	19,815	310	Degreasing(56%); Dry cleaning(44%)
Phenol				
Phosgene				
Propylene oxide	3.5			
Toluene	684	11,718	3200	Gasoline engines(96%)
o-Toluidine				
1,1,2-Trichloroethane		2,700		
Vinyl chloride	2			PVC production(100%)
Vinylidene chloride				Landfills
Xylenes	159	5,220		Gasoline engines(96%)

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[a] Reference 1: SCAQMD Report, Sept. 30, 1983; excludes landfills

[b] Reference 2: KVB Report to ARB, Report #5804-714, June 1978; for stationary sources only based on 1976 inventory

[c] Reference 3: KVB Report to ARB, Report #70-801000-1905, July 1983; for stationary sources only.

radicals, atmospheric residence time and/or half-life, percentage loss in 12 hours of daylight, and reactivity class (Table 4); and

- rating factors based on
    - extent of use in California,
    - emissions potential,
    - dispersion potential,
    - observed ambient air concentrations,
    - stability in air, and
    - degree of toxicity and/or carcinogenicity,

are given in Table 5. Definitions of the rating factors used are given in Table 6. For simplicity the o-, m- and p-cresols and the o-, m- and p-xylenes are represented as cresols and xylenes in these tables.

From Table 2, one can see that the mean ambient concentration of most compounds is at sub-ppb levels, with a few exceptions (e.g. acetaldehyde, acrolein, benzene, formaldehyde, toluene and xylenes). Quantifying species at sub-ppb levels would require sophisticated sampling and analytical methods (discussed below). Because of the secondary origins of acetaldehyde, acrolein and formaldehyde from photochemical reactions, these compounds were eliminated from further consideration.

In Table 3 wide discrepancies are seen between data sources, even allowing for the fact that the SCAQMD emissions estimates are for both stationary and mobile sources and the KVB estimates are for stationary sources only. The SCAQMD estimate that 96% of the approximately 177,000 tons of formaldehyde emitted yearly into the air is from photooxidation, and not from primary sources, reinforced the decision to delete this compound from further consideration. There are also some discrepancies between atmospheric levels in Table 2 and emissions data in Table 3. Evidently some chloroform sources were overlooked, judging from the ambient levels around 0.1 ppb. The benzene:toluene:xylene ratio reported by SCAQMD (16,790:684:159) appears inconsistent not only with data from Table 2, but with other data reported. KVB's estimated yearly emissions of the three compounds from stationary sources (34:11,700:5200) are not consistent with the SCAQMD figures. However the KVB emission levels are not consistent with mean ambient concentrations in ug/m^3 measured in Los Angeles by ERT (1983) of 45:151:130.

Thus it is obvious that even neglecting the reactivity of the compound, estimates of ambient concentration based on emissions inventory will depend on the completeness of the inventory, and are probably a poor substitute for direct measurements of the

TABLE 4. REACTIVITY OF HAPS

Compound	Rate Constant $10^9 k_{OH}$ (l. molecule^{-1}s^{-1})			Atmospheric Residence Time (days)	Atmospheric Half Life (days)				Percent loss in one Day (%)		Reactivity Class
	Ref 1	Ref 2	Ref 3	References 1,2	Ref 3	Ref 4	Ref 5	Ref 6	Ref 1,2	Ref 7	Ref 1-6
Acetaldehyde		16		0.03-0.2*			0.38		<75	5	5
Acrolein		44		0.2			0.23	0.11	>80	5	5
Acrylonitrile		2		5.6			2.5		17	-	3
Allyl chloride		28		0.3			0.4	0.38	>80	4	5
Aniline		-		-					-	-	-
Benzene	1.4	-	0.85	8.3	0.1-1			3.0	11	1	2
Benzyl chloride		3		3.9					23	4	3
Carbon tetrachloride	<0.001	<0.001		>11,000				70	<0	1	1
Chlorobenzene	0.4	0.4		13-28		0.94†			~3	-	2
Chloroform	0.1	0.1		116				0.54†	1	3	1
Chloromethyl ether		4		0.02-2.9*				0.02	29	5	4
Chloroprene		46		0.2				<0.4	>80	4	5
Cresol		55	20.5	0.01-0.1					>80	4	5
p-Dichlorobenzene	0.07	0.3		165					0.6	-	2
1,1-Dichloroethane	0.26	-	0.16	44	1-10				2	3	2
1,2-Dichloroethylene	4	-		2.9		0.32†			29	4	4
1,4-Dioxane		3		3.9		0.74		0.4†	23	5	3
Dioxin		-		-					-	3	-
Epichlorohydrin		2		5.8		1.7		0.12†	17	5	3
Ethylene dibromide		0.25		45				0.03†	2	3	2
Ethylene dichloride	0.22	0.22	0.13	53	1-10			9.0	2	3	2
Ethylene oxide		2		5.8				0.12†	17	5	3
Ethylene trichloride	2.2	2.2		5.3		0.38†	2.2	0.3†	17	4	3
Formaldehyde		10		0.1-1.2*				0.05	>50	5	5
Hexachlorocyclopentadiene		59		0.2					>80	1	5
Hexachloroethane	<0.001	-		>11,000					<0	1	1
Maleic anhydride		60		0.1					>80	-	5
Methyl chloride	0.05	-	0.025	231	>10			365	0.4	3	1
Methyl chloroform	0.02	0.012	0.0009	580	>10	>29			~0.2	3	1
Methylene chloride	0.15	0.14	0.084	80	1-10	>10			1.3	3	1

(cont.)

Table 4. (cont.)

Nitrobenzene		0.06		190					0.5	-	1
Nitrosodimethylamine		39		<0.1				0.04	>80	-	5
Nitrosomorpholine		28		<0.4					>80	3	5
PCB		<1		>11					<10	1	2
Perchloroethylene	0.17	0.17		68		1.5†		2.0†	1.5	1	1
Phenol		17		0.7				<0.4	≥75	4	5
Phosgene		0		-					-	1	-
Propylene oxide		1.3		8.9				0.12†	10	5	2
Toluene	6	6	3.6	1.9	0.1-1	0.74			41	4	4
o-Toluidine		-		-					-	-	-
1,1,2-Trichloroethane	0.02	-		580		1.7†			0.2	3	2
Vinyl chloride	6.6	-		1.8		0.46		0.5	43	4	4
Vinylidene chloride	4	4		2.8		0.23†	0.7	1.0	29	4	4
Xylenes	16	16	7-14	0.7	0.01-0.1	0.32			≥75	4	5

References:
(1) EPA 600/3-79-107, H.B. Singh et al, Nov. 1979; [OH] = $2x10^6$ molecules/cm^3
(2) EPA 600/3-80-084, L.T. Cupitt, August 1980; [OH] = $2x10^6$ molecules/cm^3
(3) SAPRC Report, J.N. Pitts, Jr., Riverside, CA., Sept. 1976; [OH] = 10^7 radicals/cm^3
(4) ES&T 10: 351, W.L. Dilling et al (1976); 10ppm cmpd plus 5ppm NO initially in a smog chamber
(5) EPA 600/3-82-092, E. Edney et al., Nov. 1982;
(6) U.S. Dept. of Commerce Report PB-80-131428, prepared by Monsanto, Jan. 1980.
(7) EPA 650/3-74-010, B. Dimitriades, Nov. 1974

* Shorter residence time includes photolysis and/or hydrolysis
† Inconsistent data
** Class 1 = <2% Loss/day; Class 2 = 2-15%/day; Class 3 = 15-25%/day; Class 4 = 25-50%/day; Class 5 = >50%/day for one 12-hour day

Table 5. RATING FACTORS FOR HAPS

Compound	Rating Factor						
	R_1	R_2	R_3	R_4	$\Sigma(R_1-R_4)$	R_5	R_6
Acetaldehyde	4	5	5	4-5	27.5	1	1
Acrolein	2	4	5	4	23	1	3
Acrylonitrile	3	4	5	~1	15	3	4-5
Allyl chloride	3	4	5	1	15	1	3-4
Aniline	3	4	3	~1	13	~2	3-4
Benzene	5	5	5	4-5	28.5	4-5	5
Benzyl chloride	2	4	3	2	15	3-4	3-4
Carbon tetrachloride	3-4	4	5	3	21.5	5	4-5
Chlorobenzene	3	4	5	3	21	4	1
Chloroform	3	4	5	2-3	19.5	3-5	4-5
Chloromethyl ether	0	2	5	~1	10	1-2	5
Chloroprene	3	4	5	~1	15	1-2	1
Cresol	2	5	3	~1	13	1-2	3
p-Dichlorobenzene	2	4	3	2	15	4	1
1,1-Dichloroethane	~2	4	5	~2	17	3-4	1
1,2-Dichloroethylene	~2	4	5	2-3	18.5	2	1
1,4-Dioxane	2	4	5	2	17	1-3	4
Dioxin	0	4	1	~1	8	3	4-5
Epichlorohydrin	2-3	2	5	~1	12.5	1-3	4
Ethylene dibromide	3	5	5	2-3	20.5	3-4	4-5
Ethylene dichloride	4-5	5	5	3-4	25	3-4	4-5
Ethylene oxide	4	4	5	~1	16	1-3	4
Ethylene trichloride	3	5	5	3-4	23.5	2-3	4
Formaldehyde	4-5	5	5	5	29.5	1	3-4
Hexachlorocyclopentadiene	0	3	1	1	7	1-5	3
Hexachloroethane	~2	4	3	~1-2	13.5	5	4
Maleic anhydride	2-3	2	1	~1	8.5	1	2-3
Methyl chloride	3	4	5	~3	21	3-5	1
Methyl chloroform	3	5	5	3	22	3-5	1
Methylene chloride	3	5	5	3	22	3-5	1

(cont.)

Table 5. (cont.)

Nitrobenzene	~2	4	3	2	15	5	1
Nitrosodimethylamine	~2	4	5	1-2	15.5	1	5
Nitrosomorpholine	~2	4	1	~1	10	1-3	4
PCB	~2	3	1	1	9	4-5	4
Perchloroethylene	3-4	4	5	3-4	23	5	4
Phenol	3-4	4	3	3	19.5	1-2	3
Phosgene	3	2-3	5	~1-2	15	5	4
Propylene oxide	3-4	3	5	~1-2	16	1-4	3
Toluene	4-5	5	5	4-5	28	2	1-2
o-Toluidine	0	4	3	~1-2	11.5	~2	3
1,1,2-Trichloroethane	0	4	5	2	15	3-4	4
Vinyl chloride	4-5	1-4	5	3-4	22.5	2	5
Vinylidene chloride	3	3	5	3	20	2	4-5
Xylenes	4-5	5	5	4-5	28	1-2	1-2

R_1: Extent of use in California; weighting factor = 1.0 in $\Sigma(R_1-R_4)$

R_2: Emissions potential; weighting factor = 1.0

R_3: Dispersion potential; weighting factor = 1.0

R_4: Ambient airborne concentration in urban areas/landfills; weighting factor = 3.0

R_5: Stability in ambient air

R_6: Evidence of carcinogenicity/toxicity.

Table 6. DEFINITIONS OF THE RATING FACTORS USED IN TABLE 5[a]

R_1: Present Use in California[b]

5. 5x10^5 ton/yr
4. 5x10^4 ton/yr
3. 5000 ton/yr
2. 500 ton/yr
1. 50 ton/yr
0. <50 ton/yr

R_2: Emission Potential[c]

5. Widespread use with poor control
4. Isolated use with poor control
3. Isolated use with fair control
2. Relatively good control over emissions
1. Tightly controlled

R_3: Dispersion Potential

5. Very volatile at 20°C
3. Vapor pressure = 0.1-2mm
1. Vapor pressure <<0.1mm

R4: Ambient Airborne Concentration

5. >10ppb
4. 1-10ppb
3. 0.1-1ppb
2. 0.01-0.1ppb
1. <0.01ppb

R5: Stability in Ambient Air[d]

5. <2% loss
4. 2-15% loss
3. 15-25% loss
2. 25-50% loss
1. >50% loss

R6: Evidence of Carcinogenicity/Toxicity

5. Known/suspected human carcinogen
4. Known/suspected mammalian carcinogen
3. Known/suspected mammalian mutagen and/or co-carcinogen
2. Non carcinogenic, but very toxic
1. Non carcinogenic, but quite toxic

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[a] Patterned after SAI Report 068-80-504 to CARB, February 19, 1979

[b] Estimated 5-10% of US total if data not available

[c] Best estimate

[d] Opposite of reactivity scale shown in Table 4 for a 12-hour irradiation

ambient concentrations. The conclusion reached by KVB (1983) that there was a good correlation between the air concentrations in Los Angeles (in lieu of Sacramento data) and the estimated emissions in Sacramento County for seven toxic air pollutants (benzene, ethylene trichloride, formaldehyde, methyl chloroform, methylene chloride, perchloroethylene and toluene) indicates that such an inventory might at best serve to give a concentration estimate within a factor of about three to aid in choosing the sampling and analytical methodologies for specific compounds. The emissions inventory does serve to eliminate several species (e.g. dioxin, epichlorohydrin, PCBs) from consideration, due to the low levels released. KVB also concluded that:

- area sources accounted for 85% of the emissions, with automobile emissions accounting for 53%,
- benzene, formaldehyde, perchloroethylene and toluene were derived primarily from area sources,
- ethylene trichloride, methyl chloroform, and methylene chloride were derived from point sources.

Photooxidation losses of most of the compounds listed in Table 4 are predominantly due to reaction with OH radicals rather than ozone. For olefins, however, the rates for reaction with OH and O_3 are often comparable for typical ambient levels of the two oxidants. Losses of several compounds may also occur by photolysis or hydrolysis (acetaldehyde, bis-chloromethyl ether, formaldehyde, maleic anhydride, dimethylnitrosamine, nitrosomorpholine). In Table 4 the percentage loss rate for each compound during 12 hours of sunlight is calculated from the reaction with OH radicals based on recent rate constant data. We have defined five arbitrary classes of reactivity based on these reaction losses (or on published atmospheric residence times in lieu of consistent rate data). Class 1 compounds undergo less than 2% loss in 12 hours, and class 5 compounds greater than 50% loss.

As part of the process to choose candidate pollutants for this study, the 48 compounds were ranked on the basis of six factors:

1) use in California,
2) emission potentials,
3) dispersion potentials at the release sites,
4) airborne concentrations,
5) stability in air,
6) degree of toxicity and/or carcinogenicity.

This approach is similar to that used by SAI (1979) in a report to the California Air Resources Board ranking potentially hazardous compounds. Each factor has been assigned a value of 0 to 5, as defined in Table 6, with "0" being low. Obviously the first three factors plus factor 5 will determine the magnitude of the ambient air concentration, i.e. factor 4. Since there are uncertainties concerning individual factors, we decided to determine an over-all ranking for each of the 48 HAPs based on equal weighting of the first three factors ($R_1 + R_2 + R_3$) and three times R_4. From this over-all ranking factor where

$$\Sigma(R_{1-4}) = (R_1 + R_2 + R_3 + 3R_4),$$

one can decide the practicality of monitoring for a specific compound. It is best to eliminate compounds that are unusually difficult to measure, and compounds that are present only in trace amounts in the atmosphere. From the over-all rankings listed in Table 5, it is evident that the 48 compounds fall into three categories: low-ranking ($\Sigma R < 10$), moderate ranking ($\Sigma R = 10\text{-}20$), and high ranking ($\Sigma R > 20$). By elimination from consideration of all compounds with an over-all ranking less than ≈15, plus acetaldehyde, acrolein and formaldehyde, the list is reduced to approximately 30; a cut-off at a rating of 20 reduces the list to 16-18 compounds. Whatever the cut-off decision, the compounds remaining on the list fall into various stability (R_5) and toxicity/carcinogenicity classes (R_6).

In the final decision it is also desirable to include compounds which are very stable in air ($R_5 = 5$) as internal tracers for monitoring dilution/dispersion, plus more reactive classes for assessing photochemical decay. Compounds with a residence time of approximately one hour or less are probably not suitable due to the uncertainty associated with the reaction rate. From the standpoint of pollutant selection, R_6 (denoting the degree of toxicity or carcinogenicity) is probably the least important factor considered. Although of great interest in other respects, this factor was considered only if the pollutants met other important criteria of the modelling study. Then compounds with the highest values of R_6 were given preference.

Appendices C and D are excerpts from previously published reports on carcinogens. Appendix C (McMillen, et al. 1980) ranks carcinogens in the U.S. based on emissions; Appendix D (SAI 1979) ranks suspected carcinogens in California.

Final Selection

The finalists in the rating process ($\approx R > 20$) fell mainly into two groups: the volatile chlorinated hydrocarbons and the benzene homolog group. Both groups are of interest to control agencies, and both are apt to be emitted by landfills. The selection was deferred until the final selection of a landfill source site was made. The benzene group was selected for study because it was expected to be emitted at any chosen source site. The methods for both groups were similar except for the specific GC detector used.

SELECTION OF SOURCE SITE

Review of Emission Sources

Known sources of hazardous air pollutants (HAPs) emissions were reviewed for suitable pollutants and sites for a field study. This was approached by examining U.S. production and manufacturing data for 48 HAPs. Chemical Week Buyer's Guide '84 and Chemcyclopedia '84 were consulted to establish U.S. annual production for the 48 compounds. This information is summarized in Table 7 for 1983, or when data for that year were not available, for 1975, the last year of complete production figures. Also included in Table 7 are the manufacturers of these compounds, with California firms indicated by upper case type. No information was found for the following compounds: bis-chloromethyl ether, 1,1-dichloroethane, 1,2-dichloroethylene, dioxin, dimethylnitrosamine, and nitrosomorpholine, with only limited data for hexachloroethane and nitrobenzene.

The locations of sources (i.e. chemical manufacturing plants) in the U.S. that emit potentially hazardous air pollutants are shown in Figure 1. This figure, which appeared originally in a National Clean Air Coalition report (March 1982), indicates that most of the emitting sources are located in Texas, Louisiana, and certain mid-western and eastern states. By comparison, emissions in the Pacific states are much lower. In California, major sources of HAPs are located in two geographic regions, the Los Angeles metropolitan area and the corridor from San Francisco Bay to the Sacramento-San Joaquin River delta.

Some of the major chemical manufacturing companies located in California manufacture one or more of the 48 HAPs of interest (see Table 8), while other firms use some of them as starting materials in the manufacture of other chemicals. The annual emissions for ten HAPs from chemical plants located in California are summarized in Table 8. Other data compiled on sources of HAPs include:

a) emissions data from chemical manufacturers in the U.S. and in California, and from stationary sources in California's South Coast Air Basin (SoCAB), as well as ambient air concentrations and source categories in the SoCAB (Table 9),

b) major industrial sources, by industry type, of high priority wastes disposed offsite in California (Table 10), and

c) annual emission figure for six major HAPs in the SoCAB as a function of industry (Table 11).

In addition to the chemical industry reviews, the possibility of using a landfill waste dump site was also investigated. Such a site might be excellent for a field study due to its customary

Table 7. U.S. PRODUCTION & MANUFACTURING DATA FOR HAZARDOUS AIR POLLUTANTS*

COMPOUND	U. S. PRODUCTION (TONS/YR)		MANUFACTURERS†
	1975	1983	
Acetaldehyde	$9.02x10^{5}$		Celanese Chem. Co, TX Eastman Kodak, NY
Acrolein	$3.05x10^{4}$		Union Carbide, CT
Acrylonitrile	$6.06x10^{5}$	$1.00x10^{6}$	American Cyanamid Co, NJ Bruck Plastics, IL DOW, TORRANCE, Du Pont, DE ICC Industries, Inc, NY Int. Comm. Exports Co, NY M-P Dajac Lab, PA Monsanto Co, MO Reed Plastics Co, MA Sohio Chemical Co, OH
Allyl chloride	$1.54x10^{5}$		Dow Chemical Co, MI M-P Dajac Lab, Inc. PA Shell Chem Co, TX
Aniline	ND	$3.25x10^{5}$	American Cyanamid Co, NJ Du Pont, DE First Chem Corp, MS Uniroyal Inc, NY USS Chemicals, PA
Benzene	$3.76x10^{6}$	$1.32x10^{6}$	Amerada Hess Corp, NY Arco Chemical Co, PA ARCO, WILMINGTON Ashland Chem Co, OH J T Baker Chem Co, NJ Captree Chemical Co, NJ Charter Oil Co, TX Coastal States Mktg. Inc., TX Conoco Chemicals, TX Cosden Oil & Chemical Co, TX Exxon Chem Americas, TX Fisher Scientific Co, NJ Getty Refining, OK Gulf Oil Chems Co, TX Koch Chemical Co, TX Marathon Petroleum Co, OH Mobile Chemical Co, TX Phillips Chemical Co, OK Rascher & Betzold, Inc. IL

(cont.)

Table 7. (cont.)

			Shell Chem Co, TX SHELL, WILMINGTON, S.W. OIL, EL SEGUNDO, CA STANDARD OIL, EL SEGUNDO Sun Refining, PA Tenneco Oil Co, TX Texaco Chemical Co. TX Union Oil Co. of Cal, IL USS Chemicals, PA
Benzyl chloride	3.50x10^{4}		Monsanto Co, MO Rit-Chem Co, NY Stauffer Chem Co, CT Velsicol Chem Corp, IL
Carbon tetrachloride	4.85x10^{5}	3.80x10^{5}	ALLIED CHEM, EL SEGUNDO J T Baker Chem, Co, NJ Dow Chemical Co, MI DOW, PITTSBURG DU PONT, ANTIOCH Fisher Scientific Co, NJ LCP Chemicals, NJ Rascher & Betzold, Inc. IL J.C.SCHUMACHER, OCEANSIDE Signo Trading Int. Ltd, NY Stauffer Chem Co, CT Vulcan Chemicals, AL
Chlorobenzene	1.63x10^{5}		Dow Chemical, MI Eastman Kodak Co, NY MONTROSE, TORRANCE PPG Industries, Inc, PA Robeco Chemicals, Inc, NY Standard Chlorine CHEM., NJ
Chloroform	1.31x10^{5}		ALLIED CHEM, EL SEGUNDO J T Baker Chem Co, NJ Captree Chemical Co, NY Diamond Shamrock Corp, OH Dow Chemical Co, MI Kem Chemical Corp, NY LCP Chemicals, NJ Mallinckrodt, Inc, MO Rascher & Betzold Inc. IL Stauffer Chem Co, CT Vulcan Chemicals, AL
Chloromethyl ether	ND		
Chloroprene	1.54x10^{5}		
Cresols	3.63x10^{4}		Bell Flavor & Fragrances, IL Biddle Sawyer Corp, NY Chemical Dynamics Corp, NJ

(cont.)

Table 7. (cont.)

			Concord Chem Co, NJ Crowley Chem Co, NY Diamond Shamrock, AL FERRO CORP, WHITTIER Koppers Co, PA Lachat Chem Inc, WI Merichem Co, TX Mobay Chem Co., PA Northwest Petrochem Corp, WA Ruetgers-Nease Chem Co., PA Sherwin Williams, OH USS Chemicals, PA
Dichlorobenzenes	$2.29x10^4$ (p-)		Kenova Chem Co, MO Monsanto, MO PPG Industries, PA Para Industries Inc, NJ Petrokem Corp, NJ SPECIALTY ORGANICS, IRWINDALE Standard Chlorine Chem Co, NJ Trueger Chemical Co, NJ Willot-Industries, MO
1,1-Dichloroethane	ND		
1,2-Dichloroethylene	ND		
1,4-Dioxane	$\sim6.90x10^3$		BASF Wyandotte Corp, NJ J T Baker Chem Co, NJ CPS Chem So, NJ Dow Chemical Co, MI Fisher Scientific Co, NJ Ferro Corp, LA Union Carbide Corp, CT
Dioxin (2,3,7,8-TCDD)	None		
Epichlorohydrin	$\sim8.99X10^4$		Dow Chemical Co, MI Shell Chem Co, TX
Ethylene dibromide	$1.38x10^5$		Ameribrom, Inc, NY D & O Chemicals, Inc, NJ Dow Chemical Co, MI Ethyl Corp, LA Great Lakes Chem Co., IN E B Knight Inc, NJ PPG Industries, Inc, PA
Ethylene dichloride	ND	$5.50x10^6$	AMERICAN CHEM, LONG BEACH BASF Wyandotte Corp, NJ Conoco Chemicals, Co, TX Diamond Shamrock Corp, OH Ethyl Corp, LA BF Goodrich, OH

(cont.)

Table 7. (cont.)

			Olin Corp, CT PPG INDUSTRIES, INC. PA Vulcan Chemicals, AL
Ethylene oxide	$2.21\text{x}10^6$	$2.65\text{x}10^6$	Balchem Corp, NY BASF Wyandotte Corp, NJ Celanese Chem Co, TX Conoco Chemicals, TX Dow Chemical Co, MI Northern Petrochemical Co, NE PPG Industries, Inc, PA Scientific Gas Prod. Inc, NJ Sunolin Chem Co, DE Texaco Chemical Co, TX Union Carbide Corp, CT & NJ
Ethylene trichloride	$1.46\text{x}10^6$		Allied Chemical, NJ J T Baker Chem Co, NJ Captree Chemical Co, NY Detrex Chem Ind., MI Diamond Shamrock Corp, OH Dow Chemical Co, MI Fisher Scientific Co, NJ Kem Chemical Corp, NJ PPG Industries, Inc, PA Par-Chem Products Inc. TX Sylvan Chem Corp, NJ Vulcan Chemicals, AL
Formaldehyde,37% by wt.	$2.28\text{x}10^6$	$2.70\text{x}10^6$	Anderson Laboratories, Inc, TX BTL of Ohio, Inc, OH BORDEN ADHESIVES, FREMONT Borden Chem, OH Captree Chemical Co, NY Celanese Chem Co, TX Du Pont, DE GEORGIA-PACIFIC, UKIAH Georgia-Pacific, GA Hercules, Inc, DE Int'l. Min. & Chem. Co. IL Monsanto Co, MO Nuodex Inc, NJ Perkins Industries Inc, KS Reichold Chems Inc, NY Wright Chemical Corp, NC
Hexachlorocyclopentadiene	5		Velsicol Chem Corp, IL
Hexachloroethane	ND		Hummel Chem Co, Inc. NJ Rhone-Poulenc Inc, NJ
Maleic Anhydride	$9.99\text{x}10^4$	$1.30\text{x}10^4$	Amoco Chems Corp, IL Ashland Chem Co, OH Denka Chemical Corp, TX

(cont.)

Table 7. (cont.)

			Monsanto Co, MO Signo Trading Int Ltd, NY Milton M Star Chemicals, NY USS Chemicals, PA
Methyl chloride	$1.83x10^5$	$1.85x10^5$	Air Products, PA Balchem Corp, NY Conoco Chemicals, TX Dow Chemical Co, MI Ethyl Corp, LA LCP Chemicals, NJ Park Chemical Co, CT Stauffer Chem Co, CT Union Carbide Corp, CT & NJ
Methyl chloroform	$2.29x10^5$	$3.30x10^5$	Captree Chemical Co, NY Detrex Chem Ind., Inc., MI Diamond Shamrock Corp, OH Dow Chemical Co, MI FOREMOST-MCKESSON,S. FRANCISCO Kem Chemical Corp, NY PPG Industries, Inc, PA Par-Chem Products Inc, TX J C SCHUMACHER, OCEANSIDE Vulcan Chemicals, AL
Methylene chloride	$2.49x10^5$	$2.50x10^5$	Allied Chemical, NJ J T Baker Chem Co, NJ Burdick & Jackson Labs, MI CPS Chem Co, NJ Captree Chemical Co, NY Detrex Chem Ind., Inc., MI Diamond Shamrock Corp, OH Dow Chemical Co, MI Fisher Scientific Co, NJ LCP Chemicals, NJ Par-Chem Products Inc, TX Stauffer Chem Co, CT Vulcan Chemicals, AL
Nitrobenzene	ND		American Cyanamid Co, NJ Du Pont, DE First Chem Corp, MS Theotron, MD
Nitrosodimethylamine	ND		
Dimethylamine			Air Products, PA Du Pont, DE GAF, NY Int'l Min. & Chem. Corp, IL Signo Trading Int Ltd, NY Union Carbide Corp, NJ

(cont.)

Table 7. (cont.)

Morpholine			BASF Wyandotte Corp, NJ Dow Chemical Co, MI Signo Trading Int Ltd, NY Texaco Chemical Co, TX
PCB's (Aroclor 1260)	$2.01x10^4$		
Perchloroethylene	ND	$2.50x10^5$	Allied Chemical, NJ ARCO Chemical Co, PA Diamond Shamrock Corp, OH Dow Chemical Co, MI DOW, PITTSBURG PPG Industries, Inc, PA Rhone-Poulenc Inc, NJ Stauffer Chem Co, CT Vulcan Chemicals, AL
Phenol	$8.72x10^5$	$1.20x10^6$	Allied Chemical, NJ CHEVRON,RICHMOND/ SAN FRANCISCO, CA Clark Chemical Corp, MO Diamond Shamrock, AL Dow Chemical Co, MI FERRO CORP, WHITTIER Geogia-Pacific Corp, GA Getty Refining, OK KAISER STEEL, FONTANA Kalama Chem, Inc, WA Mallinckrodt, Inc, MO Merichem Co, TX Monsanto Co, MO Northwest Petrochem Corp, WA Rhone-Poulenc Inc, NJ Shell Chem Co, TX Signo Trading Int Ltd, NY Milton M Star Chemicals, NY USS Chemicals, PA R T Vanderbilt Co, CT
Phosgene	$3.96x10^5$		Orsynex, Inc, OH PPG Industries Inc, PA Union Carbide Corp, NJ Van De Mark Chem Co, Inc, NY
Propylene Oxide	$7.59x10^5$	$9.00x10^5$	ARCO Chemical Co, PA Dow Chemical Co, MI Texaco Chemical Co, TX Union Carbide Corp, NJ
Toluene	$2.31x10^6$	$1.08x10^6$	Allied Chemical, NJ Amerada Hess Corp, NY ARCO, WILMINGTON ARCO Chemical Co, PA Ashland Chem Co, OH J T Baker Chem Co, NJ

(cont.)

Table 7. (cont.)

			Charter Chems, Charter Oil, TX Coastal States Mktg Inc, TX Crowley Chemical Co, NY Exxon Co USA, TX Fisher Scientific Co, NJ Getty Refining, OK Gulf Oil Chems Co, TX Kem Chemical Corp, NY Koch Chemical Co, TX Marathon Petroleum Co, OH Mobile Chemical Co, TX Phillips Chemical Co, OK Rascher & Betzold, Inc, IL Shell Chem Co, TX Signo Trading Int Ltd, NY Sun Refining, PA STANDARD OIL OF CA, EL SEGUNDO Tenneco Oil Co, TX Texaco Chemical Co, TX Union Oil Co Of Cal, IL USS Chemicals, PA
Toluidine	~2		BASF Wyandotte Corp, NJ Du Pont, DE First Chem Corp, MS Kem Chemical Corp, NY M-P Dajac Lab, Inc, PA
1,1,2-Trichloroethane	~0.5		Dow Chemical Co, MI
Vinyl chloride	ND	3.40x10^{6}	Air Products, PA Borden Chem, OH Conoco Chemicals, TX Dow Chemical Co, MI Ethyl Corp, LA Georgia-Pacific Corp, GA B F Goodrich, OH Ideal Gas Prod, Inc, NJ PPG Industries, Inc, PA STAUFFER CHEM. CO, CARSON Uniroyal, Inc, NY
Vinylidene Chloride	~7.26x10^{5}		Dow Chemical Co, MI PPG Industries, Inc, PA
Xylenes	ND	2.18x10^{6}	ALLIED CHEM, EL SEGUNDO Allied Chemical, NJ Amerada Hess Corp, NY Anderson Lab. Inc., TX Ashland Chem Co, OH J T Baker Chem Co, NJ Captree Chemical Co, NJ Charter Chems, Charter Oil, TX CHEVRON,RICHMOND/SAN FRANCISCO Coastal States Mktg Inc, TX

(cont.)

Table 7. (cont.)

Crowley Chemical Co, NY
Exxon Co, USA, TX
Fisher Scientific Co, NJ
Gulf Oil Chems Co, TX
Kem Chemical Corp, NY
Marathon Petroleum Co, OH
Phillips Chemical Co, OK
Rascher & Betzold Inc, IL
Shell Chem Co. TX
Signo Trading Int Ltd, NY
Sun Refining,Marketing Co, PA
Tenneco Oil Co, TX
Union Oil Co of Cal, IL
USS Chemicals, PA

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* Sources: Chemical Week Buyers' Guide '84, McGraw Hill, New York, NY, October 1983; Chemcyclopedia '84, American Chemical Society, Washington, DC. 1983

+ California manufactures in "caps".

Figure 1. Location of U. S. Sources Emitting Hazardous Air Pollutants

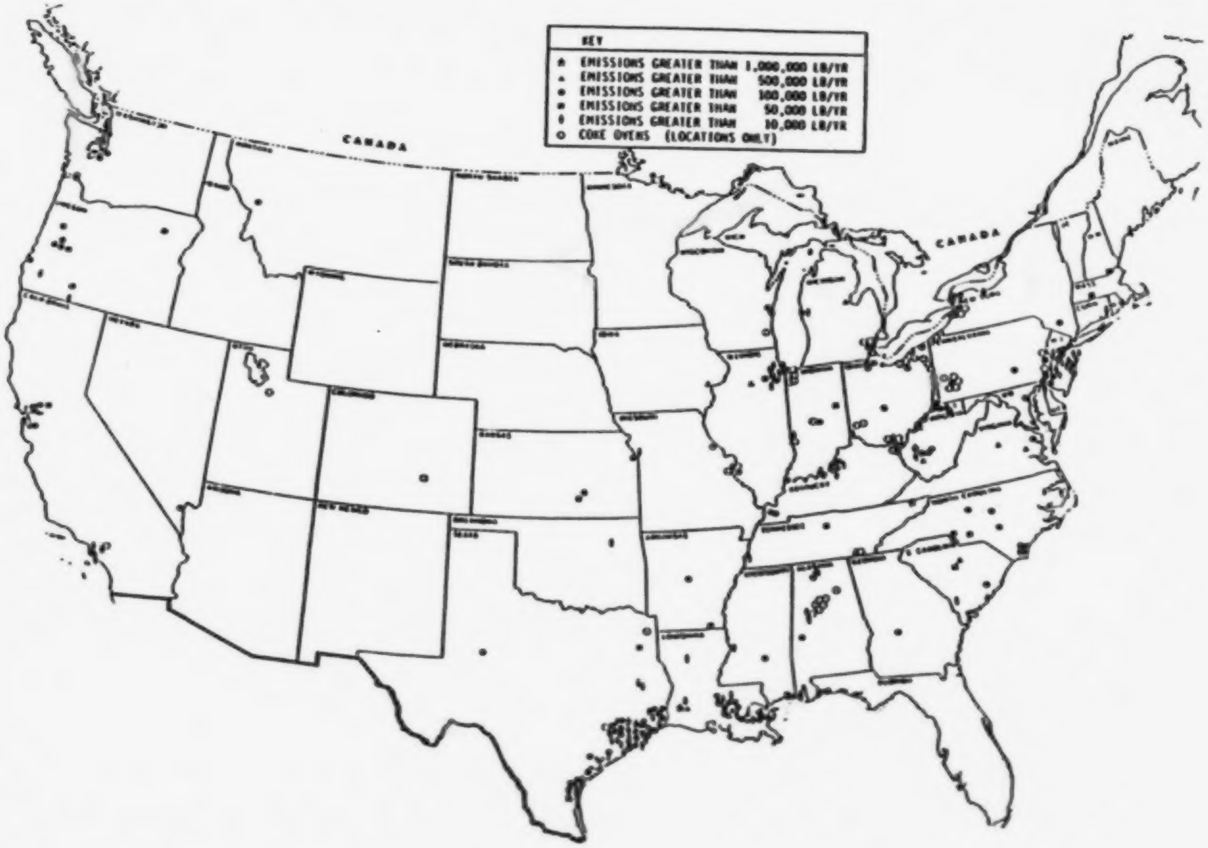
KEY
★ EMISSIONS GREATER THAN 1,000,000 LB/YR
▲ EMISSIONS GREATER THAN 500,000 LB/YR
● EMISSIONS GREATER THAN 100,000 LB/YR
■ EMISSIONS GREATER THAN 50,000 LB/YR
♦ EMISSIONS GREATER THAN 10,000 LB/YR
○ COKE OVENS (LOCATIONS ONLY)
CANADA
CANADA

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Table 8. CALIFORNIA MANUFACTURERS OF TOXIC ORGANICS

Chemical	Location	Company	Annual Emissions (tons/year)
Acrylonitile	Torrance	Dow	10
Carbon tetrachloride	El Segundo	Allied Chem.	29
	Pittsburg	Dow Chemical	46
	Antioch	Du Pont	38
Chlorobenzene	Torrance	Montrose	6
Chloroform	El Segundo	Allied Chem.	58
Cresols	Sante Fe Springs	Ferro	15
Dichlorobenzene(o,p)	Irwindale	Specialty Organics	5
Formaldehyde	Fremont	Borden	85
Perchloroethylene	Pittsburg	Dow Chemical	22
Phenol	Sante Fe Springs	Ferro	6
	Richmond	Standard Oil of CA	47
Xylenes(o,m,p)	El Segundo	Allied Chem	3
	Richmond	Standard Oil of CA	21

Source: Major Industrial Sources of Potential Toxic Air Pollutants, National Clean Air Coalition, Washington, D. C. March 1982.

Table 9. EMISSIONS DATA FOR HAZARDOUS AIR POLLUTANTS

	Estimated 1980 Emissions, tons/year				
Compound	USA[a]	California Chemical Manufacturers[a]	SCAB[b]	Ambient Concentration in SCAB[b] (ppm)	Source Types in SCAB[b]
Acetaldehyde	2,427				
Acrolein	51				
Acrylonitrile	2,573	10			
Allylchloride	240				
Aniline					
Benzene			3,378	1-10,000	Paints, oil, gasoline, landfill, combustion, inks, adhesives, printed circuit board (pcb) stripper
Benzyl chloride	50				
Carbon tetrachloride	32,515	113			
Chlorobenzenes	87,688	6			
Chloroform	12,020	58			
Chloromethyl ether					
Chloroprene	1,762				
Cresols	12,295	15			
Dichlorobenzenes	32,585	5			
1,1-Dichloroethane					
1,2-Dichloroethylene				1-10	Landfill gas
1,4-Dioxane				0.1-1.0	Vapor degreaser solvent
Dioxin (2,3,7,8-TCDD)	0.04				
Epichlorohydrin	240				
Ethylene dibromide					

(cont.)

Table 9. (cont.)

Ethylene dichloride	1,559				
Ethylene oxide	996				
Ethylene trichloride	120,350				
Formaldehyde	16,500	85	2,426	1-100	Combustion sources
Hexachlorocyclopentadiene	30				
Hexachloroethane					
Maleic anhydride					
Methyl chloride				1-10	Printed circuit board (pcb) stripper, process plant
Methyl chloroform	269,365		2,595	1-1,000	Metal degreasers, pcb stripper
Methylene chloride	203,850			1-10,000	Landfill, inks, pcb stripper, paint
Nitrobenzene	6,520				
Nitrosodimethylamine	100				
Nitrosomorpholine					
PCB's	15				
Perchloroethylene		22	19,815	0.1-1,000	Adhesive, enamel, landfill, degreasers
Phenol	3,462	53			
Phosgene	127				
Propylene oxide	673				
Toluene	1,117,921		11,718	1-10,000	Similar to benzene
1,1,2-Trichloroethane			2,700		
Vinyl chloride					
Vinylidene chloride				0.1-1.0	Landfill gas
Xylenes (o,m,p)	400,651	24	5,220	1-1000	Similar to benzene

a - Source: Major Industrial Sources of Potential Toxic Air Pollutants, National Clean Air Coalition, Washington, DC 1982.

b - Source: Control of Hydrocarbon Emissions from Stationary Sources in the California South Coast Air Basin, KVB Report 5804-714, Tustin, CA, June 1978.

Table 10. MAJOR GENERATORS OF 4 TYPES OF HIGH-PRIORITY WASTES DISPOSED OFFSITE IN CALIFORNIA

SIC Code	Industry	Halogenated Organics Tons/year	%	Non-Halogenated Volatile Organics Tons/year	%	Pesticides Tons/year	%	PCB's Tons/year	%
28	Chemical & Allied Products	26,499	56	36,149	47	65,070	90		
37,45	Transportation Equipment, incl. Air	2,762	6	7,299	9				
36	Electric & Electronic Equipment	1,100	2	102	Trace				
26	Paper & Allied Products	24	Trace						
30	Rubber & Misc. Plastic Products	6	Trace		60	Trace			
35	Machinery, except Electrical	890	2	1,164	1.5				
73	Business Services	127	Trace	208	Trace				
13	Oil & Gas Exploration	100	Trace	163	Trace				
29	Petroleum & Coal Products	6,341	13	12,166	16			24	2
38	Instruments & Related Products	111	Trace	722	1				
49	Electric, Gas & Sanitary Services	5,891	12	11,436	15			834	62
--	US Naval Bases & Operations	3,625	8	7,037	9				
34	Fabricated Metal Parts	12	Trace					480	36
20,96	Food & Kindred Products, FDA					2,500	3		
07	Agricultural Services					4,654	6		
--	Producers with Unidentified SIC Codes	30	Trace	336	Trace				
	TOTALS	47,600	100	76,842	100	72,232	100	1,338	100

Source: Toxic Waste Assessment Group Report to the Governor of the State of California "Alternatives to the Land Disposal of Hazardous Wastes", 1981.

Table 11. ANNUAL EMISSIONS FOR 6 HAPS FOR CALIFORNIA'S SOUTH COAST AIR BASIN BY INDUSTRY

Industry	Emissions, tons/year					
	Benzene	Formaldehyde	Perchloroethylene	Toluene	Methyl chloroform	Xylenes
Petroleum Production	1240	Trace		502		0.4
Petroleum Refining	666	490	216	815		413
Petroleum Marketing	382	11	34	834		746
Organic Solvents, surface coating	54		178	5788		1934
Organic Solvents, degreasing			5497		2595	
Organic Solvents, dry cleaning			12835			
Organic Solvents, other	10	9	7	1285		17
Chemical	103	18	27	49		16
Metallurgical	90	11		8		trace
Mineral	20	trace		trace		
Waste Burning	2	trace		trace		
Combustion of Fuels	124	1787		34		
Food and Agricultural	3			55		66
Pesticide Use	674			274		822
Unclassified		67	1020	2072		1206
Miscellaneous Industries		33				
Total	3378	2426	19815	11718	2595	5220

Source: KVB Report to CARB #5804-714, June 1978.

isolation and the fact that it is a source of many different air pollutants, some hazardous. At the initiation of the review there were six class I dump sites in California that could accept hazardous liquid wastes. These are listed in Table 12, with their estimated tonnages. Three of the largest disposal sites are within three hours drive from the GGC laboratory, and were considered more carefully.

Evaluation of Potential Sites

The most important criteria for choosing a source site were considered to be: high stable emission rates from either an isolated or a unique source, stable meteorology, and access to the site. Based on these criteria, the most likely candidate sites for sampling in Southern California would be either a major isolated refinery, an active class I or II-1 landfill, a large holding basin for liquid wastes, or an industrial park where many small operations are concentrated. For modelling purposes, the terrain should not be too hilly for a downwind distance of at least one km, unless tracer release is contemplated (or a stable "natural" tracer is emitted along with the study compounds).

Industrial Sources- To estimate the levels of emissions necessary for useful atmospheric sampling at a given detection limit, the Gaussian plume model was used. The assumptions made are as follows:

1) Pollutants emanate from a continuous point source
2) Steady state process; i.e. $dC/dt = 0$
3) Major transport direction due to wind is chosen to lie along the x-axis
4) Wind speed is constant
5) Transport of pollutant due to the wind in the x direction dominates over downwind diffusion
6) C approaches C_0 as t approaches 0
7) C approaches 0 as x, y, or z approaches infinity
8) No diffusion into the surface
9) Rate of transport of pollutant downwind is constant and equal to the emission rate (Q) of the pollutant at the source
10) Concentration (C) of pollutant in the cross wind and vertical directions is normally distributed.

For a point source at ground level, the concentration of a pollutant at ground level along the centerline (i.e. along the x-axis) is given by the equation:

$$C(x,0,0) = Q/\pi U\sigma_y\sigma_z \qquad (1)$$

where C = concentration of gas in units of $\mu g/m^3$ (or equivalent ppb)
Q = emission rate in units of $\mu g/s$

Table 12.

SUMMARY OF VOLATILE OR TOXIC WASTES DISPOSED OF IN CLASS I FACILITIES

(Ton/Year)*

Facility	Group				
	1	2	3	4	Total**
BKK Landfill, West Covina	20,142	45,842	84,701	53,430	163,920
IT Environmental, Martinez	2,514	39,108	72,108	0	75,966
Liquid Waste Disposal, Kettleman Hills	14,460	21,834	34,644	13,116	64,656
IT Environmental, Benecia	1,530	3,870	16,434	0	18,090
WCC Sanitary Landfill, Richmond	1,986	516	3,648	3,324	9,150
Casmalia Disposal Company Casmalia	2,304	3,864	10,688	102	14,760

Group:

1. Potentially Volatile Waste Likely to Contain Minerals of High Toxicity
2. Potentially Volatile Waste Containing Halogens
3. Potentially Volatile Organic Wastes
4. Potentially Volatile Pesticide Wastes

* Extrapolated from two months of data.

** Totals are not arithmetic sums because some categories of waste overlap two groups.

Source: UCD Study Data for Offsite Disposal, cited in CARB Report "An Assessment of the Volatile and Toxic Organic Emissions from Hazardous Waste Disposal in California". February, 1982, Table VIII-I, p.20.

U = windspeed in units of m/s
σ_y, σ_z = plume standard deviations in cross wind and vertical directions, respectively, in meters

Thus C(x,0,0) varies directly with the emission rate and inversely with the wind speed. Other equations are applicable for other situations such as point sources elevated above ground level (i.e. from a stack), line sources, or multiple sources.

Values for σ_y and σ_z have been estimated as a function of distance downwind from a source for various atmospheric stability classes A to F (Turner 1970). Calculation of the ground level centerline concentration of a pollutant from equation (1) based on Turner's estimates for σ_y and σ_z are generally within a factor of two to three of the observed values if the sampling times are approximately 10 minutes, and terrain is open and flat. As a matter of practicality, it is very difficult, if not impossible, to monitor the dispersion of a pollutant for wind speeds below ~1.0m/s.

If we assume:

- that the average wind speed is 2m/s (i.e. ~5mph),
- the detection level of a specific analytical method for a pollutant is 3ug/m^3 (i.e. 1.0ppb for benzene),
- the stability of the atmosphere is class B (i.e. normal for moderate to strong solar radiation and a wind speed of 2-5m/s),

then the ground level emission rate Q of the pollutant from a point source has to be at least 236 lb/yr to detect the pollutant 100m downwind of the source; at a distance of 2km (i.e. 20 times farther) the emission rate would need to be greater than 56 tons/yr (i.e. 463 times larger; see Table 13).

TABLE 13. MINIMUM EMISSION RATE TO DETECT 1PPB BENZENE AS A FUNCTION OF DOWNWIND DISTANCE
(Ground-level point source, stability class B, windspeed 2m/s)

Downwind Distance, x (m)	Emission Rate, Q (tons/yr)
100	0.12
200	0.36
500	1.96
1000	11.1
2000	55.6
10000	>20000.

On an overcast day, the atmosphere is considered to be neutral and have a stability class D. For windspeed 2m/s, the emission rate for detectable levels at distances of 2000m and 10000m would need to be ≈4.1 and ≈49 tons/yr respectively. [Note: For the most stable conditions, class F, which generally only occurs at night with very clear skies, the emission rates would only need to be ≈0.85 and ≈8.5 tons/yr for downwind distances of 2km and 10km respectively. Nighttime sampling, however, is not practical for obvious reasons]. If the sensitivity of the analytical method were ten times higher than in the above examples (allowing the detection of 0.1ppb benzene) the required emission rates would be a factor of ten lower. From practical experience, however, it is best to be aware that the actual concentration may be substantially less than that calculated from equation (1) on the previous page. This is a conservative allowance for the known variation of 2- to 3-fold between calculated and observed concentrations.

Another consideration in determining how large a source needs to be is the minimum atmospheric residence time required to detect photochemical decay of a pollutant. An air mass moving at 2m/s for a distance of 2km is equivalent to a residence time of only 16.7 minutes, hardly long enough to monitor accurately the photochemical decay of even the most reactive pollutant. For a residence time of one hour, the equivalent distance is 7.2km for and air mass moving at 2m/s, which for class B stability (i.e. moderate to strong solar radiation to enhance photochemical reactions) would require a major emission source (e.g. a large urban plume >6000 tons/yr if the detection limit is 1ppb, or >600 tons/yr if the detection limit is 0.1ppb).

In addition to the requirement that an extremely sensitive analytical method be available for the pollutants of interest (e.g. 0.1-1ppb, or better), the measurement of photochemical decay of several reactive pollutants demands that the source be extremely large (i.e. at least 6 tons/yr, for a downwind distance of 2km, if the detection limit is ≈0.1ppb). The source must also be isolated (i.e. no other source within several km) or unique in the type of emissions. These restrictions on the size and isolation of the source could be relaxed considerably if photochemical decay is not monitored.

With these considerations in mind, the SCAQMD emission inventory of September 1983 for hazardous organic pollutants was reviewed for the major industrial stationary sources within the SoCAB, as summarized in Table 14. One drawback of using this emission inventory is that emissions from landfills and water/wastewater treatments are not included.

The source areas considered were extended to examine the NEPS data base for total annual hydrocarbon emissions from major stationary sources within approximately 100 miles of Los Angeles

Table 14. SCAQMD Emissions Inventory for Major Stationary Sources of HAPS

Compound	Company	Emissions (tons/year)
Acetaldehyde	ND	----
Acrolein	ND	----
Acrylonitrile	DOW Chemical, Torrance	2
Allylchloride	ND	----
Aniline	ND	----
Benzene	ARCO, Carson	
Benzene	Chevron, El Segundo	
Benzene	Mobil Oil, Torrence	
Benzene	Shell Oil, Wilmington	
Benzene	Union Oil, Los Angeles	
Benzene	Plus 14 other smaller refineries Refineries, total	106
Benzene	Gasoline Marketing	472
Benzene	Witco Chemical Corp., Los Angeles	16
Benzylchloride	ND	----
Carbon tetrachloride	Allied Chem., El Segundo	3 (1982); Trace (1983)
Carbon tetrachloride	Neville Chem., Santa Fe Springs	4
Chlorobenzene	Montrose, Torrance	<6
Chloroform	Allied Chem., El Segundo	Trace (1983)
Chloromethyl ether	ND	----
Chloroprene	ND	----
Cresols	Ferro Corp., Whittier	<15
p-Dichlorobenzene	Specialty Orgs, Irwindale	<5
1,1-Dichloroethane	ND	----
1,2-Dichloroethylene	ND	----
1,4-Dioxane	Degreasing, total	330

(cont.)

Table 14. (cont.)

1,4-Dioxane	Robert Shaw Controls Co., Long Beach	2.6
1,4-Dioxane	Rohr Ind., Inc.	0.6
Dioxin	ND	----
Epichlorohydrin	Magna Corporation	0.03
Ethylene dibromide	AmVac Chem Corporation, Los Angeles	1
Ethylene dibromide	Ethyl Corp., Los Angeles	0.3
Ethylene dichloride	Rohr Ind., Inc.	0.3
Ethylene dichloride	Bard Cardiopulmonary, Santa Ana	2
Ethylene dichloride	American Bentley, Irvine	1.2
Ethylene dichloride	GATX, San Pedro	0.3
Ethylene oxide	Allergan Pharmaceutical, Irvine	10.0
Ethylene oxide	American Bentley, Irvine	13.0
Ethylene oxide	Cal Compact Foods, Santa Ana	13.0
Ethylene oxide	Inspiron Resp. Div., Rancho Cucamonga	16
Ethylene oxide	Lonza, Long Beach	12.5
Ethylene oxide	Micro-Biothrol Co., Vernon	75.3
Ethylene oxide	Pharmaseal Labs, Glendale	120
Ethylene oxide	Sterilizing Services of CA, Anaheim	18.3
Ethylene oxide	Plus 8 others sterilization/surfactant sources	1-8 each
Ethylene trichloride (TCE)	Garner Glass Co.	3.2
Ethylene trichloride (TCE)	Douglas Aircraft, Torrance	4 (1981); 2.3 (1982)
Ethylene trichloride (TCE)	MGM Labs, Inc., Culver City	5 (1981); 2.7 (1982)
Ethylene trichloride	Total all degreasing operations	741
Ethylene trichloride	Total all storage and handling	36
Ethylene trichloride	Total all misc. use (incl. filter processing)	30
Formaldehyde	Consumptive Uses	134
Formaldehyde	Fuel Combustion (incl. mobile sources)	7443
Hexachlorocylopentadiene	ND	----

(cont.)

Hexachloroethane	ND	----
Maleic anhydride	Alpha Resins	3
Methylchloride	ND	----
Methyl chloroform	1. Storage/handling (Ashland Chem, Sante Fe Springs; Dow Chemical, Torrance; GATX, San Pedro)	20.8
Methyl chloroform	2. Degreasing/cleaning (Individual sources coded by ETS ID#: 1-160 each)	14129
Methyl chloroform	3. Aerosols	1295
Methyl chloroform	4. Adhesives	1554
Methyl chloroform	5. Misc.	1425
Methyl chloroform	6. Landfills and/or water treatment	not measured
Methylene chloride	1. Storage and handling, total (GATX, San Pedro; Harpers, Torrance; Neville Chem Co., Santa Fe Springs)	49.5
	2. Metal Degreasing, Total	2724
	Aerojet, Downey	29.2
	Airesearch, Torrance	10.2
	Bell Ind., Compton	26.4
	Bentley Lab., Irvine	12
	Burroughs Corp., Westlake Village	6.9
	Ciba Geigy, Santa Ana	8.6
	Carbon Armco, Riverside	19.3
	Diceon Electronics, Irvine	70
	Electro-Motive, Commerce	25
	Gould Inc., El Monte	23
	Harpers, Torrance	106
	Kennedy Co., Monrovia	7
	Rockwell Int'l., Newport Beach	11
	Spectra-Strip, Garden Grove	6.5
	US Polymeric, Santa Ana	8.5
	Western Electric, Commerce	3.7
	3. Aerosols, total (Lawson Chem., Torrance; National Aerosol Prod., Los Angeles; Spray on Prod., Anaheim)	3170
Methyl chloroform	4. Foam blowing, total (United Foam, Los Angeles; E.R. Carpenter, Riverside)	520
Methyl chloroform	5. Pharmacentical Solvent, total (Anabolic Inc., Irvine - 23.5) (Bentley Labs., Irvine - 12)	660

(cont.)

Table 14. (cont.)

	(Pharmavite Pharm., Arleta - 105)	
Methyl chloroform	6. Paint Removers, total (American Can, Carson - 15.5) (Dip N strip, Costa Mesa - 9.1) (Sunset Strip, Huntington Beach - 7.3)	3036
	7. Misc. solvent, total	2770
	(Anabolic Inc. Irvine)	23.5
	(Narmco Materials, Anaheim)	20.3
Nitrobenzene	ND	----
Nitrosodimethylamine	ND	----
Nitrosomorpholine	ND	----
PCB's	Rockwell Int'l., Los Angeles	0.01
Perchloroethylene	1. Dry cleaning, total (Individual sources coded by EIS ID#: 1-120 each)	6025
	2. Degreasing, total (Individual sources coded by EIS ID#: 1-224 each)	7668
	3. Storage and handling, total	3
Phenol	Ferro Corp., Whittier	<6
Phosgene	ND	----
Propylene oxide	Tretolite, Brea	1.7
Propylene oxide	Amvac Chem. Co., Los Angeles	1.0
Propylene oxide	Lonza Inc., Long Beach	0.6
Toluene	Audio Magnetics Corp.	335
Toluene	Starkist Foods Can Plant	38
Toluene	Keysor-Century Corp., Saugus	34
Toluene	Northrop Corp., Nopair Div.	27.5
Toluene	Paper Coating Co., Los Angeles	18
Toluene	Harpers, Torrance	9.5
Toluene	Avery Int'l., Pasadena	9.5
Toluene	Stewart Film screen	8
Toluene	Cont. Corp of America	7.8

(cont.)

Table 14. (cont.)

Toluene	DPC Co., Los Angeles	7.3
Toluene	Reliance Universal, Fullerton	7.2
Toluene	Solvent Coating Corp., Torrance	6.0
Toluene	Rockwell Int'l., Los Angeles	5.5
Toluene	Refineries (Arco, Wilmington; Chevron, El Segundo)	No data
O-Toliudine	ND	----
Trichloroethane	ND	----
Vinyl chloride	1. PVC Production, total (Stauffer Chem., Carson) 2. PVC fabrication (Keysor Century Corp.)	1.3 0.8
Vinylidene Chloride	ND	----
Xylene	Refineries (Arco, Chevron)	No data
Xylene	Northrop Corp., Nopair Div.	28.2
Xylene	Reichhold Chem. Azusa	17.7
Xylene	Harpers, Torrance	12.4
Xylene	Reynolds Metals, Torrance	6.8
Xylene	Rockwell Int'l., Los Angeles	5.5

(Table 15). Most of these are located in heavily industrialized areas of Los Angeles County, but several very large sources exist in the less industrialized (and possibly more isolated) areas of Kern and Ventura Counties. Unfortunately there is no breakdown by chemical compound in this data base. From the Ventura County Department of Environmental Health a list of hazardous waste generators was obtained. This has a breakdown by chemical type (Table 16) and includes manufacturing sites with a potential for elevated concentrations in air of hazardous organic pollutants (Table 17), and waste water treatment plants (Table 18).

It was estimated by Barcelona (1979), that the chlorination of Los Angeles city water resulted in the addition of 80 kg/day of chloroform to the Los Angeles Air Basin (volume $\approx 10^{12} m^3$) resulting in an increase in chloroform concentration of 80 ng/m^3 above the background of 20 ng/m^3. The release of chloroform to the air would be ≈13 tons/yr from the Hyperion waste water treatment plant located on the coast in El Segundo (see Figure 2), if we assume a 50% loss of chloroform from the primary effluent containing 47ug/l chloroform. Concentrations of other organic pollutants in Hyperion's primary waste water effluent are summarized in Table 19. Downwind concentrations of these species could easily reach several ppb or more within a short distance of the plant.

KVB's emission inventory for Sacramento County (KVB 1983, to CARB) is reproduced in Tables 20 and 21. Engineering Science has prepared a report to USEPA OAQPS (Weant and McCormick, 1983) documenting the non-industrial sources of potentially toxic substances. The report also considered in general terms the applicability of source apportionment using toxic substances and listed industrial sources of potentially toxic substance emissions. (The industrial listing is excerpted in Appendix E). The report states that the principal focus of the project was nonindustrial sources of toxic emissions. (Nonindustrial sources are those sources which are not directly associated with an industrial process and include such things as wastewater treatment facilities, waste disposal sites, and waste piles, as well as natural sources. Fugitive emissions from product or raw material storage facilities were considered as industrial emissions. The investigation of nonindustrial sources was initiated because the possibility existed that these sources could emit significant amounts of toxic substances which could have an impact on receptor sites remote from the source, thereby confounding a receptor analysis. It was hoped that the information on nonindustrial sources presented in the report could be used to assist in source apportionment by alerting the receptor modeler to the potential interference by emissions from these sources and by allowing the modeler to adjust for such nonindustrial emissions. The report cautions that the emission data were collected from a variety of literature sources, and therefore their reliability can not be judged. (Weant and

Table 15. Total Annual HC Emissions for Major (i.e. >10 tons/year) Stationary Sources within approximately 100 miles of Los Angeles

Source Name	City, County	HC Emissions (tons/year)	SIC Code Description
Acme Ludlow Packaging	Temple City, LA	541	Plastics
Alco Rotogravure	North Hollywood, LA	1093	Printing
Allen Industries	Compton, LA	21	Synthetic rubber
Allied Chemical	El Segundo, LA	95	Organic chemicals
American Cyanamid	Azusa, LA	96	Coated fabrics
Arco	Carson, LA	7823	Petroleum refining
Arco	Southgate, LA	248	Petroleum storage
Arco	Los Angeles, LA	44	Petroleum storage
Armorlite	San Marcos, R	828	Plastics
Arnold Engineering	Fullerton, O	124	Electrical apparatus
Asphalt Const. Co.	Ridgecrest, K	15	Paving mixtures
Asphalt Const. Co.	Littlerock, LA	39	Paving mixtures
Bradford White Corp.	Vernon, LA	118	Boiler fabrication
Calnev Pipeline	Bloomington, S.B.	98	Petroleum storage
Central Plants	Los Angeles, LA	18	Steam supply
Champion Parts	Industry, LA	341	Machinery
Champlin Petroleum	Wilmington, LA	234	Petroleum refining
Champlin Petroleum	Wilmington, LA	98	Petroleum storage
Chevron Chemical Co.	Los Angeles, LA	113	Surface active agents
Chevron USA	El Segundo, LA	1099	Petroleum refining
Chevron USA	Bakersfield, K	26	Petroleum refining
Chevron USA	Van Nuys, LA	1559	Petroleum storage
Chevron USA	Los Angeles, LA	43	Petroleum storage
Chevron USA	Paramount, LA	148	Petroleum storage
Chevron USA	Montebello, LA	358	Petroleum storage
Chevron USA	Lakewood, LA	35	Petroleum storage
Chevron USA	La Mirada, LA	511	Petroleum storage
Coast Converters	Los Angeles, LA	85	Printing
Coastal Petro. Ref.	Paloma, K	?	Petroleum refining
Coastal Petro. Ref.	Kern, K	?	Petroleum refining
Copp Paving Co.	Santa Fe Springs, LA	438	Paving mixtures
Delux General	Los Angeles, LA	187	Photographic supplies
Dilectron	Monrovia, LA	198	Electrical apparatus
E.L. Yeager Constr.	Rubidoux, R	362	Paving mixtures
EDP Petroleum	Signal Hill, LA	35	Petroleum refining
Edgington Oil	Signal Hill, LA	178	Petroleum storage
Ehone Plating	Santa Ana, O	129	Plating
Fiberite	Orange, O	27	Coated fabrics
Filtrol Corp.	Vernon, LA	189	Inorganic chemicals
Fletcher Oil	Carson, LA	139	Petroleum refining
Four Corners Pipeline	N. Long Beach, LA	696	Petroleum storage
Four Corners Pipeline	Long Beach, LA	6200	Petroleum storage
Gal-Ten-Light Metals	Upland, S.B.	587	Metal work
GATX	Carson, LA	1588	Petroleum storage
GATX	San Pedro, LA	1408	Petroleum storage
Getty Refining	Bakersfield, K	44	Petroleum refining
Getty Refining	Kern, K	201	Petroleum refining
Golden Eagle	Wilmington, LA	46	Petroleum storage
Golden Eagle	Torrance, LA	184	Petroleum refining
Granite Constr.	Santa Paula, V	?	Paving mixtures
Great Western Carpet	Orange, O	813	Plastics
Gulf Oil	Santa Fe Springs, LA	1142	Petroleum refining
Hunt Mix	Wilmington, LA	52	Paving mixtures
Imperial Metal	Los Angeles, LA	312	Metal coating
Industrial Asphalt	Sun Valley, LA	88	Paving mixtures
Industrial Asphalt	Saticoy, V	?	Paving mixtures
INMECO	Los Angeles, LA	351	Metal coating
Ivec/Mulco	Kern, K	?	Petroleum refining/storage
Kaiser Steel	Fontana, S.B.	6455	Steel mill
Kelco/Merck	San Diego, S.D.	6036	Organic chemicals
Kern Oil	Lamont, K	64	Petroleum refining
Keysor-Century	Saugus, LA	156	Plastics
Kimstock	Santa Ana, O	952	Plastics
Kirsch Co.	Brea, O	273	Millwork
Kleerpak-Comapo	North Hollywood, LA	177	Printing
Koppers Co.	Oxnard, V	118	Plastics
L.A. City Asphalt	North Hollywood, LA	228	Paving mixtures
La Reyte Corp.	Simi Valley, V	36	Paving mixtures
LARCO Industries	Anaheim, O	1949	Plastics
Liken Home Furnishing	Westminster, O	381	Drapery hardware
Lunday-Thagard	Southgate, LA	38	Petroleum refining
MacMillan Ring Free	Signal Hill, LA	58	Petroleum refining
Manchester-Tank & Co.	Lynwood, LA	182	Boiler fabrication
Marlex Petroleum	Long Beach, LA	158	Petroleum refining
Mattel Inc.	Industry, LA	266	Plastics
McDonnel Douglas	Huntington Beach, O	116	Defense
Menasco Mfg. Co.	Burbank, LA	168	Plating
MICA Corp.	Culver City, LA	38	Plastics
Mobil Chemical Co.	Bakersfield, K	2888	Plastics
Mobil Oil	Terminal Island, LA	897	Petroleum storage
Mobil Oil	Vernon, LA	225	Petroleum storage
Mobil Oil	Anaheim, LA	33	Petroleum storage
Mobil Oil	Torrance, LA	6239	Petroleum refining
Mobil Oil Pipeline	Kern, K	?	Petroleum storage
Modine	Whittier, LA	281	Metal coating
New Fashion Cleaners	Los Angeles, LA	159	Dry cleaning
Newhall Refining	Newhall, LA	49	Petroleum refining
Northrup Corp.	Newbury Park, V	?	Defense
Oildale Readymix	Bakersfield, K	?	Paving mixtures
Oxnard Refinery	Oxnard, V	?	Petroleum reifning
Pacific Oasis	Paramount, LA	416	Petroleum refining
Petroleum Transport	Kern, K	?	Petroleum refining
Plastic Dress-Up Co.	S. El Monte, LA	228	Plastics
Polycarbon Inc.	North Hollywood, LA	185	Weaving mills
Potlach	Pomona, LA	247	Printing
Powerine Oil Co.	Long Beach, LA	288	Petroleum storage
Powerine Oil Co.	Santa Fe Springs, LA	2128	Petroleum refining
Procter and Gamble	Long Beach, LA	9368	Detergents
Road Oil Sales	Kern, K	65	Petroleum refining
Rotary Offset Printers	Anaheim, O	56	Printing
SCA Paint & Body	El Monte, LA	?	Paint shops
Sabre Oil Refinery	Bakersfield, K	?	Petroleum refining
Sabre Oil Refinery	Kern, K	?	Petroleum refining
San Diego Pipeline	Orange, O	46	Petroleum storage
San Joaquin Refinery	Bakersfield, K	16	Petroleum refining
Shell	Wilmington, LA	2853	Plastics
Shell	Carson, LA	753	Petroleum storage
Shell	Los Angeles, LA	272	Petroleum storage
Shell	Long Beach, LA	139	Petroleum storage
Shell	Dominguez, LA	1327	Petroleum refining
Shell Chemical	Carson, LA	178	Organic chemicals
Sierra Anchor	McKittrick, K	?	Petroleum refining
Simplot Soil Builder	Edison, K	?	Agricultural chemicals
Sloane Dry Cleaners	Pico Rivera, LA	27	Dry cleaning
So. Calif. Refining	Carson, LA	30	Petroleum storage
So. Pacific Milling	Simi Valley, V	?	Paving mixtures
Soule Steel Co.	Los Angeles, LA	150	Steel mill
Sunland Refining	Bakersfield, K	?	Petroleum refining
Sunland Refining	Kern, K	?	Petroleum storage
Texaco	Wilmington, LA	1665	Petroleum refining
Texaco	Long Beach, LA	126	Petroleum storage
Texaco	Carson, LA	964	Inorganic chemicals
Torrance Tube	Torrance, LA	59	Steel mill
Tosco Corp.	Bakersfield, K	6069	Petroleum refining
Triangle Picture	Los Angeles, LA	48	Painting
U.S. Polymeric Corp.	Santa Ana, O	857	Coated fabrics
Union Oil	Torrance, LA	61	Petroleum storage
Union Oil	San Pedro, LA	125	Petroleum storage
Union Oil	Wilmington, LA	253	Petroleum storage
Union Oil	Simi Valley, V	?	Petroleum storage
Union Oil	Los Angeles, LA	184	Petroleum storage
Union Oil	Wilmington, LA	2436	Petroleum refining
U.S. Navy Construction	Port Hueneme, V	48	Paving mixtures
U.S. Steel	Torrance, LA	96	Steel mills
USA Petrochem	Ventura, V	approx. 5	Petroleum refining
USAF Norton AFB	San Bernardino, SB	188	National security
USDE - Navpet Reserves	Tupman, K	?	Petroleum storage
USMC AS-EL TORO	Santa Ana, O	146	National security
USMC Camp Pendelton	Oceanside, S.D.	158	National security
USN Miramar NAS	San Diego, SD	498	National security
USN NARF	San Diego, SD	1586	National security
USN Naval Station	San Diego, SD	826	National security
USN PMC Missile Range	Point Mugu, V	188	National security
USN SUP CTR-FUEL	San Diego, SD	149	Petroleum storage
USN Training Center	San Diego, SD	179	National Security
Vernon Asphalt Co.	Gardena, LA	218	Paving mixtures
Vernon Leather Co.	Vernon, LA	214	Leather tanning
West Coast Oil Co.	Oildale, K	approx. 5	Petroleum refining
Western Metals	La Mirada, LA	31	Metal work
Western Metals	El Segundo, LA	13	Printing
Witco Chemical	Lynwood, LA	87	Organic chemicals
Witco Chemical	Oildale, K	23	Petroleum refining
Witfield Chemical	Carson, LA	24	Surface active agents
Xerox Corp.	Irvine, O	92	Photographic supplies

Notes:

1. Counties: LA = Los Angeles; K = Kern; O = Orange; R = Riverside, SB = San Bernardino; SD = San Diego; V = Ventura
2. Data from NEDS, some of which is 12 years old.
3. Included sources in Kern and Ventura counties even when total HC emissions data are not available.

Table 16. Hazardous Waste Source Areas in Ventura County for Selected Hazardous Organic Chemicals

Company	Address	Annual Usage of Hazardous Compounds (gallons) Methyl Chloroform	Xylene	TCE	PERC	Toluene
Abex	W. 5th St., Oxnard	---	---	3600	---	---
Amplica	950 Lawrence, Newbury	55	---	---	---	---
Air Cooling Technology	553 Constitution Ave., Camarillo	2200	---	---	---	---
American Nucleonics	696 Hampshire Rd. Westlake Village	330		---	---	---
Augat Interconn. Syst.	Newbury Park	2500	---	---	---	---
Alonian Enterprises	2696 Lavery Court, NP	360	---	---	---	---
Clifford Mfg.	Camarillo	---	110	175	---	---
Cloud Tone	2630 Lavery Court, NP	1500	---	---	---	---
California Amplifier	3481 Old Conejo Rd., T.O.	900	---	---	---	---
Darby Circuits	Simi Valley	---	---	1320	---	---
Del Mfg.	Oxnard	>500	---	---	---	---
Everest & Jennings	Camarillo	>300	---	---	---	---
Haliburton	Industrial Pk., Perkins Rd. Oxnard	---		---	---	---
Gaiser Tool	Ventura	1800	---	---	---	---
Janus Enterprises	Ventura	500	---	---	---	---
Master Plating	Ventura	ND	---	---	---	---
Northrup Corp.	1515 Rancho Conejo Rd., N.P.	(No data in file).				
Polycorp Electronics	Tourmaline, NP	(No data in file)				
Ronlo Engineering	840 Tourmaline Dr., NP	2000	---	---	---	---
Rockwell Int'l, Sci. Ctr.	Newbury Park	7*	---	60*	---	---
Rockwell Int'l	Santa Susana	---	---	250+	---	---
Silicone Detector Corp.	855 Lawrence Dr., NP	(No data in file)				
Semtech Corp.	652 Mitchell Road, NP	---	---	---	---	50
Talley Corp.	Newbury Park	(No data in file)				
Teledyne Electronics	649 Lawrence Dr., NP	3120	27	---	40	---
3M **	Camarillo			---	---	
Vetco	250 W. Stanely, Ventura	---		---	---	

* Disposed off-site; + Spill in 1983; ** 400 gallon MEK/oilwaste spill in 1983; 3M has efficient solvent recovery system.

Table 17. Manufacturing Sites in Ventura County with a Potential for Elevated HAP Concentrations

Site	Comments
Haliburton, Perkins Road, Oxnard	Oilfield operations; in large industrial park.
Talley Corporation, Newbury Park	Large machine shop.
Ventura Oil Co., 3815 Vineyard, Oxnard	Petroleum Storage/distribution.
Vetco, 250 W. Stanley, Ventura	Major painting operations for drilling rigs, close to freeway and other oilfield operations.
3-M Company, Camarillo	Potential for high MEK emissions. Isolated source, 1/4 mile West of Rt. 101.
Norris Island, Carpenteria	Isolated, small offshore island handling oil distribution from offshore wells.
Getty and Shell Oil Depots, Ventura	Petroleum wastes such as drilling muds handled on-site; liquid wastes hauled to Casmalia, Kettleman Hills or Taft.
Industrial Parks	Concentration of many small operations.
eg. Newbury Park (Lawrence Drive) Camarillo Ventura Oxnard (Perkins Road)	Large open field downwind of Newbury Park industrial park complex.

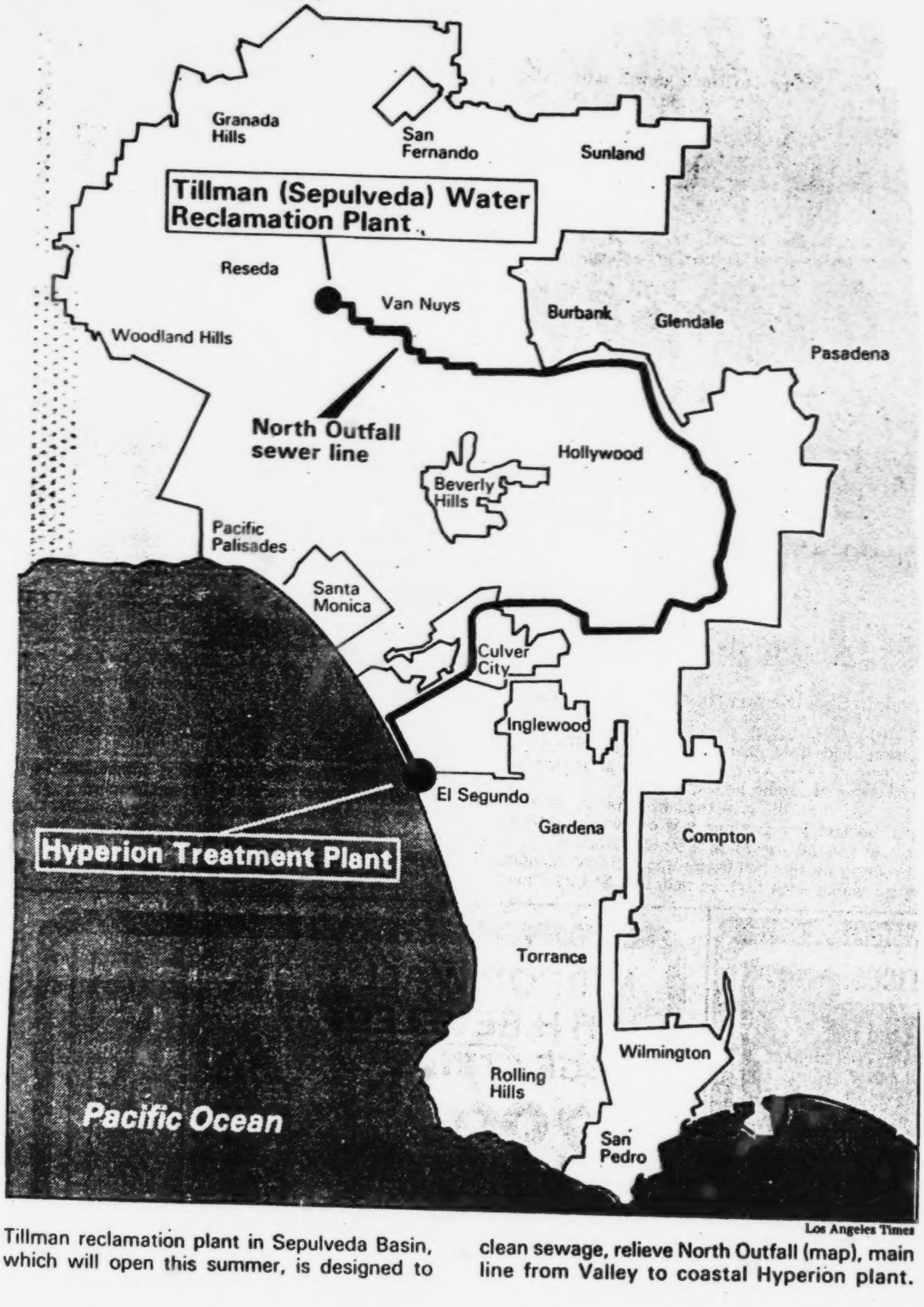
Table 18. Waste Water Treatment Plants in Ventura County

Ventura County	Daily Capacity (MGD)*	Comments
Oxnard, Perkins Road	>20	Not isolated, near industrial park.
Ventura, Harbor Blvd.	20	Mobil oil storage tanks nearby. On the coast, with prevailing on-shore winds during the day. Private golf course downwind.
Hill Canyon, Thousand Oaks	---	Isolated, but located in very small canyon.
Camarillo	7	Isolated; located in 0.5X1 mile canyon suronded by rolling hills. Prevailing winds run length of canyon.
Santa Clara, Santa Paula	---	Accepts brine and contaminated water from oil drilling operations; utilizes 6 large evaporating ponds; expect continuous emissions of oil waste products (eg. xylenes).
Los Angeles County		
Hyperion , El Segundo	400*	Located next to Los Angeles Airport.

* MGD: Million gallons/day

** Assuming 50% loss of chloroform from Hyperion's effluent containing 47ppb chloroform (Barcelona, 1979), chloroform emissions would be ~40 kg/day resulting in chloroform concentrations of 100ppb and 1ppb, 100m and 1000m, respectively, downwind of the source.

FIGURE 2.


Granada Hills
San Fernando
Sunland
Tillman (Sepulveda) Water Reclamation Plant
Reseda
Van Nuys
Burbank
Glendale
Pasadena
Woodland Hills
North Outfall sewer line
Hollywood
Beverly Hills
Pacific Palisades
Santa Monica
Culver City
Inglewood
El Segundo
Hyperion Treatment Plant
Gardena
Compton
Torrance
Wilmington
Rolling Hills
Pacific Ocean
San Pedro

Los Angeles Times

Tillman reclamation plant in Sepulveda Basin, which will open this summer, is designed to clean sewage, relieve North Outfall (map), main line from Valley to coastal Hyperion plant.

Table 19. Concentration of Organic Pollutants in Hyperion's Primary Waste Water Effluent (July 1977)

Compound	Concentration (μg/liter)
Benzene	28±13
Chloroform	47±17
1,1-Dichloroethane	14±5
1,1-Dichloroethylene	20±5
Ethylene trichloride	160±40
Methyl chloroform	340±250
Methylene chloride	410±200
Perchloroethylene	290±120
Phenol	32±8
Toluene	310±150

TOTAL EFFLUENT = 5×10^{11} liters/year

Reference: D.R. Young, Southern California Coastal Water
Research Project Annual Report,
El Segundo, CA 1978

Table 20. 1982 SACRAMENTO COUNTY AREA SOURCE EMISSIONS,

PERCENT OF TOTAL FOR THE COUNTY SORTED BY PROCESS CODE

Chemical No.		101 Benzene	350 Formaldehyde	576 Perchloro'n	738 Toluene
Process No.	Description				
710	On-road Motor Veh.	48	66		76
610	Pesticide Applic'n	29			
330	Surface Coating	11		18	5
720	Off-road Motor Veh.	3	6		6
141	Utility Equipment	3	5		5
440	Vehicle Refueling	3			7
310	Dry Cleaning			82	
740	Aircraft		17		
730	Trains	<1	3		
142	Mobile Equipment	<1	1		1
340	Asphalt Paving	2			
640	Constr'n & Demol'n	<1	2		
410	Tanks	<1			
300	Solvent Use		1		
112	Space Heaters	<1	<1		
140	Equipment	<1	<1		
100	Fuel Combustion	<1	<1		
400	Liquid Storage	<1			
420	Tank Cars & Trucks	<1			
110	Boilers & Heaters	<1	<1		
	TOTALS	100	100	100	100

Table 21. 1982 SUMMARY INVENTORY OF TOXIC POLLUTANT EMISSIONS FROM SACRAMENTO COUNTY, TONS/YEAR

Chemical No.	Name	101	262	350	576	738	743	744	Total	Percent of Total
		Benzene	Methylene Chloride	Formal-dehyde	Perchloro-ethylene	Toluene	Trichloro-ethane	Trichloro-ethylene		
Point Sources										
Process No.	Description									
320	Degreasing				35		480	36	550	7
300	Solvent Use		370		3	5			380	5
330	Surface Coating	4				170			175	2
410	Tanks	1				10			11	<1
500	Industrial Process		4	1					5	<1
	All Others	1		5	1	3			10	<1
	Totals (Point Sources)	6	370	6	39	188	480	36	1130	15
	% of Total/Chemical	<1	100	<1	12	6	100	100	15	
Area Sources										
Process No.	Description									
710	On-road Motor Veh.	870		900		2300			4100	53
610	Pesticide Applic'n	530				2			530	7
330	Surface Coating	200			53	130			380	5
720	Off-road Motor Veh.	60		76		180			320	4
141	Utility Equipment	50		65		160			280	4
440	Vehicle Refueling	50				200			250	3
310	Dry Cleaning				240				240	3
740	Aircraft			230					230	3
	All Others	60		100		50			210	3
	Totals (Area Sources)	1820		1370	290	3000			6500	85
	% of Total/Chemical	<99		<99	88	94			85	
	Grand Totals	1840	370	1360	330	3200	480	36	7700	

McCormick, 1983).

The background information from this report played a part in the selection process of the source to be used in this study, principally in broadening it beyond consideration of industrial sources only.

Landfill Sources- Table 12 above lists the six largest class I landfills in California at the start of this project. A summary of various HAPs found at several Class I and Class II landfills determined by CARB and SCAQMD are shown in Table 22. Elevated concentrations of aromatics and chlorinated hydrocarbons (i.e. >100ppb) were observed approximately 100m downwind from high level emission points ("hotspots") located at different landfill sites. Concentrations measured approximately one to two kilometers from these hotspots were often insignificantly different from background urban concentrations. Dilution of landfill gases increased from approximately 500:1 to >100,000:1 as the downwind distance from emission loci increased. A description of the California landfill sites investigated by CARB is given in Table 23. Sketches of these sites are shown in Appendix F. The closest of the possible sites were either not accessible (Kettleman), no longer accepted liquid wastes (West Covina, McColl, Palos Verdes, Puente Hills, Monterey Park), or had unsuitable terrain or meteorology (Casmalia).

Two additional sites were investigated: the Santa Clara Wastewater Treatment plant in Ventura County, and a Class II-1 landfill near Taft, in the southern San Joaquin valley. The Santa Clara plant has several large evaporating basins to handle brine or oily wastes and is located in a flat area. The plant handles only small amounts of wastes (<2000 bbl/day) of which the petroleum waste is much less than 0.1%. Other potential sources of petroleum emissions are located nearby. The downwind area beyond about 100m consists of private residences.

The Taft site is an 80-acre site about 120 miles from Los Angeles, which handles approximately 7000 bbl/day of petroleum wastes (brines, drilling muds, acids, caustics). A schematic of the layout is given in Figure 3. The facility is open 24 hr/day. Normal winds during summer are from the northwest during daylight hours. The facility is isolated and located in flat terrain. It is accessible for on-site sampling and examination of manifests, with permission from the operators. The site is ten years old and could accept up to 10% of its loads as chlorinated hydrocarbons, but at the time of the investigation was doing so only on an extremely limited basis. It was estimated that the air concentrations of most chlorinated hydrocarbons would be undetectable. However, the levels of benzene and its volatile homologs were expected to be substantial.

Table 22. Summary of Landfill monitoring for HAPs by CARB/DHS*

Site(s)*	Dates	Compared Concentration of HAPS (ppb)			
			Casmalia	Kettleman Hills	West Covina
(I) Seven sites	11/79-12/79	Benzene		+	+
		Toluene		+	+
		Xylenes		+	+
		PERC		+	+
		TCE		+	+
		Vinyl			+
		chloride			+

			On-Site	Test Hole	Off-Site
(II) McColl (a)	10/80	6 compounds	2-24[b]	---	0.3-15[b] (3 miles away)
(b)	11-60-12/80	Benzene	18-330[c]	40	<50
		Toluene	16-32	---	---
		Xylenes	<20	---	---
		Chloroform	1	2	1
		Carbon tetrachloride	0.2	0.4	0.3
		Methylchloroform	3	5	3
		Methylene chloride	---	---	150(?)
		PERC	3	3	3
		TCE	1	1	1

		Upwind Site 100 yds. from Well 184	Downwind Site 75 yds. from Well 164	Average of 5 residential downwind sites	Landfill Gas[d]
(III) West Covina 9/82-10-82					
	Benzene	<10	40	5	100,000
	Chloroform	<1	<1	0.6	>500
	Carbontet.	<1	<1	---	<1
	Dichloroethylene	<100	<100	---	>7000
	Ethylene dibromide	<1	<1	---	<1
	Ethylene dichloride	<20	200	2	100,000
	Methyl chloride	<100	<100	---	<100
	Methyl chloroform	40	100	---	30
	Methylene chloride	<20	<20	---	40
	PERC	400	3000	3	80,000
	TCE	40	90	3	40,000
	Vinylchloride	10	30	5	500,000
	Vinylidene chloride	<10	<10	---	60,000

(cont.)

Table 22 (cont.)

		Palos Verdes		Puente Hills	
		Upwind	Downwind	Upwind	Downwind
(IV) Palos Verdes & Puente Hills 2/83	Benzene[e]	NO	100	NO	400
	Toluene[e]	NO	800	NO	NO
	Xylene[e]	NO	2000	NO	NO
	Chloroform	0.04	0.04	NO	0.02
	Ethylene dichloride	NO	0.13	NO	0.11
	PERC	0.4	8.5	0.4	3.5
	TCE	0.8	4.5	1.1	1.4
	Vinyl chloride	NO	NO	NO	NO
(V) Monterey park (0.1) 4/83-5/83	Vinyl chloride	<0.2-13			
(VI) Benecia (IT) 4/84	Planned study				

FOOTNOTES

* Monitoring performed by CARB, SCAQMD and Health Services personnel, using Tedlar bags and/or Tenax traps to sample ambient air at 100 cc/min. for 2-12 hours. Analyses performed either by AIHL (Berkeley) or Haagen-Smit Lab (El Monte).

[a] 7 sites include: Vine Hill and Baker (Martinez), Carmalia, Kettleman Hills, Simi Valley, West Covina/BKK, and Palos Verdes; raw QC/MS data not reduced.

[b] Sum of benzene, chloroform, carbon tetrachloride, methylchloroform, trichloroethylene (PERC).

[c] Elevated benzene concentrations observed at several hot spots: 2-25 ppm.

[d] Average value based on combination of measurements made directly from gas collection lines, wells, and flux cans inverted over hot spots near-wells; concentrations ranged over two orders of magnitude.

[e] Values for aromatics are suspected of being too high according to Los Angeles County Sanitation District which operates the Palos Verdes and Puente Hills landfills.

+ Present but not quantitated

CONCLUSIONS

(I) Observed significantly higher C_2-C_5 concentrations downwind of West Covina and Kettleman Hills sites compared to upwind. No significant differences for other sites.

(II) Observed insignificantly higher concentrations on site vs. offsite, except for local hot spots of benzene and C. alkyl phenols from refinery wastes.

(III) Observed wide variation in concentrations in various gas collection lines indicating hot spots; ratio of concentration in landfill gas to ambient air concentration range from approximately 500:1 to approximately 100,000:1.

(IV) According to Los Angeles County District, they suspect contaminated samples based on high values for aromatics. Freon-12 and benzene were approx. 8 ppm and 50 ppm, respectively, in the landfill gas. Since the gradient in Freon-12 concentration measured upwind vs. downwind was 0.37 ppb, the dilution factor for Freon-12 is approx 22,000:1. Thus the downwind concentrations of benzene should be approx. 50,000/22,000, or 2 ppb higher than the upwind concentration.

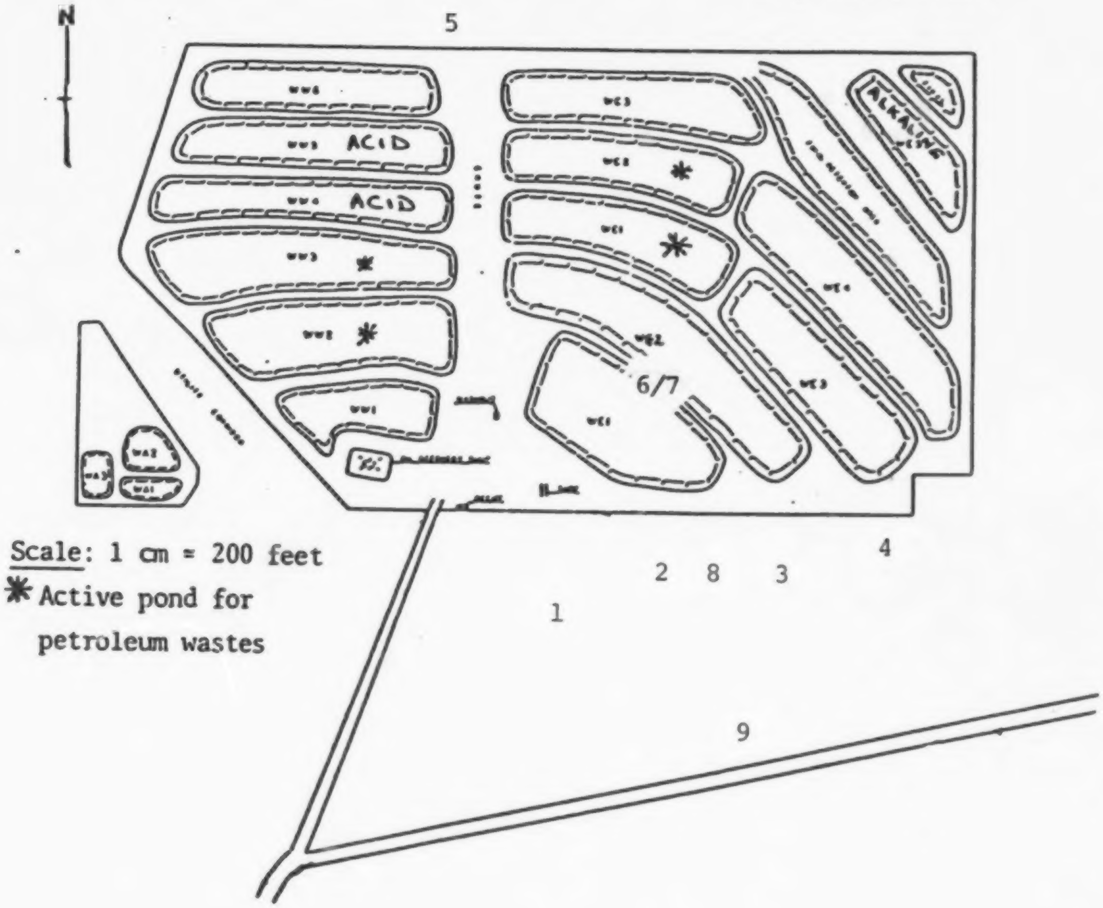
(V) suspect illegal dumping of vinyl chloride at this landfill site.

Table 23. Description of California Landfill Sites Investigated by CARB

Sites	Operator	Comments
Vine Hill/Baker (Martinez)	IT Corporation	Accept limited liquids and sludges utilize evaporation, soil blending. Flat area surrounded by industrial site complex (oil refineries)
Casmalia Class I	Casmalia Resources	Accepts general debris, sludges, pesticides and PCB's. Uses entrenchment and burial. Isolated foothill area surrounded by higher hills.
Kettleman Hills Class I	Chemical Waste Mgmt.	Accepts most wastes. Uses soil blending. Isolated hilly location.
Simi Valley Class I + II (Inactive Class I)	Ventura County Sanitation District	Accepts liquids, sludges, solid wastes. Uses soil burial and entrenchment. In wide canyon surrounded by hills.
West Covina Class I	BKK	Accepts liquids, sludges, solid wastes. May phase out liquids by May 84. Uses soil burial and entrenchment;to install vapor recovery system in 1984. Adjacent to residential area with little or no industrial sectors.
Palos Verdes Class I (inactive) Torrance	Los Angeles County Sanitation District	Accepted liquids, sludges, solid wastes. Used soil burial and entrenchment. Methane recovery unit (1 million cfm per day) Located in sloping foothills, adjacent to residential area.
Puente Hills Class II	Los Angeles County Sanitation District	Accepts limited liquid wastes. Extensive gas collection system.
McColl Class II (Inactive) (Fullerton)		Accepted refinery wastes Adjacent to residential area
Monterey Park (To close in 1984)	Operating Industries	Handles limited refinery wastes Methane recovery unit (8 million cfm per day). Adjacent to industrial park and residences.

Figure 3. Sampling Details of Pilot Study at Taft Landfill Site on 9-28-84.

(Wind=NNW @ 5-8kt)
Temperature = 95°F



Scale: 1 cm = 200 feet
✱ Active pond for petroleum wastes

Test #1 (1407-1441 PDT)

Sample ID	Volume (liters)
1	8.5*
2	8.5
3	8.5
4	8.5

Test #2 (1604-1648 PDT)

Sample ID	Volume (liters)
5	11.0
6,7†	11.0
8	11.0
9**	19.5

* Volume may be lower by ~ 20% due to poor flow measurement

† Colocated samplers

** Pair of Tenax cartridges in series

Final Site Selection

A brief examination of the Taft site was made and three simultaneous preliminary Tenax adsorption tube samples (not of the final configuration) were taken on the evening of June 23, 1984. These were taken upwind and downwind (to about 300m) by means of radio signals, as described in the next section on methodology. On September 28, 1984, The GGC project manager and the EPA project officer for this contract revisited the site, to make a final decision on its proposed selection for the study, and to further test the remote control system. Nine Tenax and five silica tube samples were taken in two runs at distances up to approximately 250m downwind. The location appeared to have suitable terrain, meteorology, and emission levels for use as the study site.

The sampling details of this pilot study are reproduced in Figure 3; analytical results are presented in Tables 24 and 25. The Tenax tubes were used in the field "as is" from the manufacturer without purging and thus a background correction from the upwind sample #5 was applied to the measured values in Table 24 to obtain the net concentrations presented in Table 25. (The cleanup procedure later adopted is described in Appendix A; these first samples were sealed with a gas torch in the field after use). The data indicates that benzene is in low concentration and does not parallel the other five aromatic compounds. The fact that benzene in the upwind sample was lower than in lab blanks suggests cartridge breakthrough for benzene for the sample volumes of 8.5-19.5 liters. Of the first four samples taken approximately equidistant downwind from the active ponds used for petroleum wastes, sample #4 had the highest concentrations for aromatic compounds, suggesting higher emissions towards this end of the landfill. Para- and meta-xylenes were the dominant compounds. In the second test, samples #5-9, the highest aromatic concentrations were observed at site #7, which is closest to the active ponds. Ethylbenzene was the dominant compound at this site. Concentrations decrease with distance from the active ponds, ethylbenzene showing the most significant decrease. It is possible that the one data point for ethylbenzene at site #7 is erroneous due to background interferences in the untreated tubes. For the tandem tubes used at site #9, concentrations of all species, with the exception of benzene and toluene, are substantially higher on the front Tenax tube than on the backup tube.

The data indicate that the sampling methodology appeared to be adequate for sampling ambient aromatic concentration levels downwind of the Class II-1 landfill. The possibility of cartridge breakthrough of some of the aromatic compounds could lead to underestimation of the ambient concentration of these species. Therefore, breakthrough tests were subsequently carried out, as described later in the report.

Table 24. Mass (ng) of Ambient Aromatic Compounds Detected on Tenax Cartridges at Taft Landfill

Compound	1	2	3	4	5*	7†	8	9-Front**	9-Back**
1. Benzene	12	1	3	24	ND	17	28	20	11
2. Toluene	94	64	40	135	13	362	130	129	113
3. Ethylbenzene	54	44	41	120	13	2346	112	195	56
4,5 p-, and m-Xylene	279	341	342	839	60	1770	868	1434	559
6. o-Xylene	33	40	39	110	4	208	120	168	40

* Sample #5 is taken upwind and thus the results are considered to give the background concentration.

** Sample #9 used two Tenax cartridges in series to check for breakthrough.

† Sample #6 and #7 were colocated; sample #6 was previously analyzed for qualitative information only.

Table 25. Ambient Concentration (ppbV) of Aromatic Compounds at EPC Landfill Site*

	Sample ID							
Compound	1	2	3	4	7	8	9-Front	9-Back
1. Benzene	0.4	<0.1	0.1	1.0	0.5	0.8	0.3	0.2
2. Toluene	2.7	1.7	1.0	4.0	8.6	2.9	1.5	1.3
3. Ethylbenzene	1.2	0.9	0.9	3.0	50.0	2.1	2.1	0.4
4,5 p-, and m-Xylene	6.3	8.0	8.1	21.7	36.6	17.3	16.0	5.5
6. o-Xylene	0.8	1.0	1.0	2.9	4.4	2.5	2.0	0.4

* Concentrations have been corrected for background, sample #5, divided by sample volume, and converted to units of ppb by volume. Lab blanks contain ∿9ng of benzene; sampling greater than 8.5 liters of air obviously decreased this value since no benzene was detected on the upwind sample #5.

As a result of these preliminary site visits, the Taft site was selected for study.

SELECTION OF METHODOLOGY

Review of Methods

The initial assembly of information on sampling methods and analytical procedures for hazardous ambient air pollutants (HAPs) was made from three sources: EPA Test Methods on Wastewater (EPA 1982), NIOSH Manual of Analytical Methods (Volumes 1-7, 1977-81), and the SKC 1983 Catalog Guide to NIOSH/OSHA Air Sampling Standards (SKC, Fullerton, CA.). The EPA methods which are designed for organics in water matrices are also potentially applicable for airborne species. Nearly all the methods involve concentrating the organic species of interest either in an impinger solution or on an adsorbent trap material (e.g. silica, charcoal, resin), desorption of the compound from the sampler, and analysis by either gas chromatography (GC), GC/MS, colorimetry, or other specific method. EPA Methods 601 through 613 involve GC, while methods 624 and 625 involve GC/MS. The type of trap materials and GC detectors are described in the procedures. It is unnecessary to include the details of these methods, which are tabulated in EPA (1982). The sampling and analytical methods approved by NIOSH and those in the SKC listing are intended for industrial safety uses, and aimed at higher concentrations than are required for ambient studies, although they might be applied to lower concentrations.

During this evaluation, later information became available from EPA and is summarized in Table 26 (Riggin, 1983). The predominant sample collection methods are whole air collection into a stainless steel canister or adsorption on ≈1-2g of Tenax (e.g. methods B, C, and D). The other methods are more highly specific and generally only applicable to compounds that we expect to be present in concentrations below the detection limit (<0.01-0.1ppb), for compounds that are highly unstable, or for compounds that have both primary and secondary sources. The detection limits for the most common methods B, C, and D are presented in Table 27.

In a previous study (Singh et al., 1981) ambient concentrations of aromatics and halogenated hydrocarbons were monitored using a SS bellows compression pump to sample ambient air and pressurize one liter SS canisters to ≈32 psig. Back in the laboratory, sample volumes of ≈500ml were transferred to and concentrated in a SS trap packed with glass beads and cooled with liquid oxygen. According to the authors, the earlier use of a Tenax trap as a preconcentrator was found unsatisfactory due to artifact formation and difficulties in quantitative adsorption and desorption. Desorption of organic compounds from the preconcentration traps was accomplished by replacing the dewar

Table 26. Recommended Sampling and Analytical Methods for Hazardous Airborne Pollutants[*]

Compound	Sampling Method[+]	Analytical Method	Comments on Sampling Problems
1. Acetaldehyde	J,K	HPLC	very unstable; $1^\circ + 2^\circ$ sources[**]
2. Acrolein	J,K	HPCL	very unstable; $1^\circ + 2^\circ$ sources
3. Acrylonitrile	B,F	GC/NPD	Concentration <0.01 ppb
4. Allylchloride	B,E,F	GC/FID	Too volatile for Tenax trap; concentration <0.01 ppb
5. Aniline	B,C,D	GC/PID	
6. Benzene	B,C,D	GC/FID	
7. Benzylchloride	B,C,D	GC/PID	Concentration approx. 0.02 ppb
8. Carbon Tetrachloride	B,C,D	GC/ECD	Low retention volume on Tenax; loss to SS surfaces
9. Chlorobenzene	B,C,D	GC/PID	----
10. Chloroform	B,C,D	GC/ECD	Low retention volume on Tenax
11. Chloromethylether	----	----	Concentration <0.01 ppb
12. Chloroprene	B,C,D	GC/PID	Concentration <0.01 ppb
13. Cresols	C,S,H	GC/PID	Concentration <0.01 ppb
14. p-Dichlorobenzene	B,C,D	GC/ECD or PID	----
15. 1,1-Dichloroethane	----	----	----
16. 1,2-Dichloroethylene	----	----	----
17. 1,4-Dioxane	----	----	Concentration approx. 0.01 ppb
18. Dioxin	----	----	Concentration <0.01 ppb
19. Epichlorohydrin	B,C,D	----	Concentration <0.01 ppb
20. Ethylendibromide	----	----	----
21. Ethylene dichloride	B,C,D	GC/ECD	----
22. Ethylene oxide	A,B,E	----	Too volatile for Tenax trap
23. Ethylene trichloride	B,C,D	GC/ECD	----

(cont.)

Table 26. (cont.)

24. Formaldehyde	J,K	HPLC	Very unstable; $1^{\circ} + 2^{\circ}$ sources
25. Hexachlorocylopentadiene	C,D,H	----	Concentration <0.01 ppb
26. Hexachloroethane	----	----	Concentration <0.01 ppb
27. Maleic Anhydride	----	----	No suitable method; conc. <0.01 ppb
28. Methylchloride	----	----	----
29. Methylchloroform	B,C,D	GC/ECD	----
30. Methylene chloride	B,F	GC/ECD	Not well retained by Tenax; better to use carbon molecular sieve
31. Nitrobenzene	B,C,D	GC/ECD, PID or NPD	----
32. Nitrosodimehtylamine	M	GC/NPD	Very low concentration
33. Nitrosomorpholine	M	GC/NPD, HPLC	Compound not stable; very low concentration
34. PCB	H	GC/ECD	Concentration <0.01 ppb
35. Perchloroethylene	B,C,D	GC/ECD	----
36. Phenol	C,S	GC/PID	----
37. Phosgene	----	Colorimetry	Very unstable
38. Propylene oxide	B,C,D	----	Low retentiton volume on Tenax
39. Toluene	B,C,D	GC/PID	----
40. O-Toluidine	----	----	Very low concentration
41. Trichloroethane	----	----	Concentration <0.01 ppb
42. Vinyl chloride	----	----	----
43. Vinylidene chloride	B,C,D	GC/ECD	Very low concentration
44. Xylene	B,C,D	GC/PID	----

*Reference: EPA Technical Assistance Document 600/4-83-027, June 1983

[+] Methods described in original documents; B = whole air collection in a SS canister with cryogenic concentration in the lab; C = Adsorption on Tenax with thermal desorption in the lab. D = Adsorption on Tenax with thermal desorption into canisters. Other methods defined in reference not applicable

** 1°, primary; 2°, secondary

Table 27. Detection Limits for Recommended Sampling and Analytical Methods for Airborne Organic Pollutants*

Method	Description	Sample Size	Detection Limit	Comments
B.	Whole air collection in a canister; cryogenic concentration; GC/FID or ECD analyses.	100 ml	0.1 ppb	Storage times greater than a week not recommended. Reactive and water-soluble compounds not readily analyzed.
C	Adsorbtion on Tenax; thermal desorption; GC/FID or ECD analysis	20 l	1-200 ppt	Blank levels limit sensitivity; potential for artifact formation; sample can only be analzed once.
D	Adsorbtion on Tenax; thermal desorption into canisters; GC/FID or ECD analysis	20 l	0.01-1 ppb	Same as above with the exception that sample can be analyzed 3 - 4 times

*GC/FID used with hydrocarbons; GC/ECD used with halogenated hydrocarbons; component identification by GC/MS is recommended.

container of liquid oxygen with one of boiling water and purging the contents onto the GC column with carrier gas. The analytical conditions used in that study for the analysis of selected toxic chemicals are reproduced below in Table 28. Calibrations were performed using permeation tubes, multiple dilutions and/or gas phase coulometry.

The general concerns associated with sampling with adsorbent traps include gas breakthrough, desorption inefficiency, and artifact formation after sampling (e.g. oxidation of a hydrocarbon species by atmospheric oxidants such as ozone). Artifact formation is also a concern with either whole air sampling or cryogenic trapping. Tenax is superior to most other adsorbents because it does not collect water vapor (and thus allows sampling of large volumes of air and has good thermal desorption properties. Tenax, however, has the disadvantage of being unable to capture highly volatile materials, such as vinyl chloride, efficiently at large sample volumes. Whole air collection techniques with SS canisters or bags made of Tedlar or Teflon also allow collection of large volumes of air. A specific disadvantage of canisters is the loss of certain specific compounds onto the walls of the canister. Bag samples must be analyzed within a few hours because gas permeation occurs through the walls of the bag. Also, outgassing from these plastic containers can cause significant interference in the accurate analysis of the collected sample. Subsequently a compendium of methods for toxic organics in ambient air appeared (Riggin, 1983). This listed five additional methods for HAPs:

Method TO-1: "Tenax GC Adsorption and GC/MS Analysis"; for volatile, nonpolar organics (e.g. aromatic and chlorinated hydrocarbons) boiling between 80 and 200°C.

Method TO-2: "Carbon Molecular Sieve Adsorption and GC/MS"; for highly volatile nonpolar organics (e.g. vinyl chloride, vinylidene chloride, benzene, toluene) boiling between -15 and +120°C.

Method TO-3: "Cryogenic Trapping and GC/FID or ECD Analysis"; for volatile nonpolar organics boiling between 0 and 200°C.

Method TO-4: "High Volume PUF Sampling and GC/ECD Analysis"; for organochlorine pesticides and PCBs.

Method TO-5: "DNPH Liquid Impinger Sampling and HPLC/UV Analysis"; for aldehydes and ketones.

The application of these methods, to those of the 48 HAPs of interest to which they apply, is summarized in Table 29. For the Tenax adsorption method TO-1, each compound has a characteristic breakthrough volume (in liters of air per gram of adsorbent) which must not be exceeded. Table 30 lists the approximate

Table 28
Analytical Conditions for the Analysis of Selected Toxic Chemicals

GC Column				Detector		Typical Carrier Gas Flow Rate (ml/min)	Typical Sample Size (ml)
No.	Description	Temp. (°C)	Species Measured	Type	Temp. (°C)		
1	6 ft X 1/8 in, SS,* 20% SP2100, 0.1% CW 1500 on 100/120 mesh Supelcoport	45	$CHCl_3$; CH_3CCl_3; CCl_4; C_2HCl_3; $CH_2ClCHCl_2$; C_2Cl_4; CH_2ClCCl_3; $CHCl_2CHCl_2$	Electron capture	325	40	500
2	33 ft X 1/8 in, Ni, 20% DC 200 on 80/100 mesh Supelcoport	45	CH_3Cl; CH_3Br; CH_2CCl_2 ; **	Electron capture	325	25	600
3	6 ft X 1/8 in, SS, 10% N, N, -bis (2-cyanoethyl) Formamide on Chromosorb P (A/W)	85	C_6H_6; $C_6H_5CH_3$; m/p/o-$C_6H_4(CH_3)_2$; 4-$C_6H_4C_2H_5$; 1,3,5 $C_6H_3(CH_3)_3$; 1,2,4 $C_6H_3(CH_3)_3$	Flame ionization	325	45	600
4	3 ft X 1/8 in, Ni, 5% SP 1200 -5% Bentone on 100/120 mesh Supelcoport	85	C_6H_5Cl; m-$C_6H_4Cl_2$; o-$C_6H_4Cl_2$; 1,2,4 $C_6H_3Cl_3$	Electron capture	325	45	750
5	15 ft X 1/8 in, SS, 10% SP 1000 on 100/120 mesh Supelcoport	45	CH_2ClCH_2Cl ; **	Electron capture	330	25	100
6	10 ft X 1/8 in, SS, 0.2% CW 1500 80/100 mesh on carbopack C	45	CH_2Cl_2; CCl_3F; cis-CHClCHCl; CCl_2FCClF_2; CH_3CCl_3; CCl_4 ; ** ; ++	Electron capture	330	40	10
7	10 in X 1/4 in, Teflon, 5% CW 400, on 60/80 mesh Chromosorb W(A/W)	30	PAN, PPN	Electron capture	30	60	5
8	5 ft X 1/4 in, SS, 30% didecyl phthalate, 100/120 mesh, Chromosorb P (A/W)	30	$COCl_2$	Electron capture	30	70	5

*Stainless steel

**Ascarite trap used with GC columns 2, 5, and 6
++Also used for CH_2CCl_2 measurement with preconcentration

Reference : H. B. Singh et al. (1981)

Table 29. Compendium of Methods for the Determination

of

Toxic Organic Compounds in Ambient Air

Compound	Applicable Method(s)	Comments
1. Acetaldehyde	TO-5	
2. Acrolein	TO-5	
3. Acrylonitrile	TO-2, TO-3	TO-3 yields better recovery
4. Allylchloride	TO-2, TO-3	TO-3 best recovery
6. Benzene	TO-1, TO-2, TO-3	TO-3 best recovery
7. Benzylchloride	TO-1, TO-3	
8. Carbon tetrachloride	TO-1, TO-2, TO-3	Breakthrough volume very low with TO-1
9. Chlorobenzene	TO-1, TO-3	
10. Chloroform	TO-1, TO-2, TO-3	Breakthrough volume very low with TO-1
12. Chloroprene	TO-1, TO-3	Methods not documented for chloroprene
14. p-Dichlorobenzene	TO-1, TO-3	
21. Ethylene dichloride	TO-1, TO-2, TO-3	Breakthrough volume very low with TO-1
23. Ethylene trichloride	TO-1, TO-2, TO-3	
24. Formaldehyde	TO-5	
29. Methylchloroform	TO-1, TO-2, TO-3	Breakthrough volume very low with TO-1
30. Methylene chloride	TO-2, TO-3	
31. Nitrobenzene	TO-1, TO-3	
34. PCB's	TO-4	
35. Perchloroethylene	TO-1, TO-2, TO-3	TO-2 performance not documented for this compound
39. Toluene	TO-1, TO-2, TO-3	
42. Vinyl chloride	TO-2, TO-3	
43. Vinylidene chloride	TO-2, TO-3	
44. Xylenes	TO-1, TO-3	

Reference: Riggin (1983)

Table 30. Approximate Break Through Volume
for
Organic Compounds on Tenax

Compounds	Break through Volume at 38°C *
Benzene	19
Carbon tetrachloride	8
Chlorobenzene	150
Chloroform	8
Ethylbenzene	200
Ethylene dibromide	60
Ethylene dichloride	10
Ethylene trichloride	20
Methylchloroform	6
Perchloroethylene	80
Toluene	97
Xylenes	200 (approx.)

* L/g Tenax

breakthrough volumes at 38°C (110°F) for several species. Since this volume is a function of temperature and possibly other sampling variables, one must ensure an adequate margin of safety (≈factor of 2) to obtain good collection efficiency. To calculate the maximum total volume of air which may be sampled through a given trap, one multiplies half of the breakthrough volume for the least retained compound of interest by the weight of Tenax in the trap. Riggin (1983) recommends that the maximum volumetric flow rate should yield a linear flow velocity of 50-500 cm/min, and that additional samples be collected in parallel for the same time period but at 2-4 times lower flow rates. Backup cartridges should also be employed frequently. Riggin (1983) finds that a 50m x 0.3mm ID fused silica bonded phase capillary column with a nonpolar stationary phase (e.g. SE-30; OV-1), temperature-programmed from 30°C to 200°C at 8°C/min is a suitable column for many situations. With large Tenax cartridges (>0.5g), thermal desorption directly onto the GC column is not rapid and thus not satisfactory. Instead the trap contents are transferred first to a cryogenic trap and then thermally flashed onto the GC column.

Walling et al (EPA 1982) developed the following simple input-output model for Tenax adsorption of atmospheric contaminants:

$$\ln C/C_o = [k_o L(t/t_s - 1)]/V_L$$

where C = bed exit concentration at elapsed time t, g/cm^3
C_o = bed inlet concentration, g/cm^3
k_o = pseudo first order rate constant, ≈200 min^{-1}
L = adsorbent bed length, cm
V_L = linear flow velocity, cm/min
t = elapsed time after beginning sampling, min
t_s = elapsed time to reach adsorbing capacity of bed

The model is valid for t/t_s = 0.1-0.8, flow rate = 35-500 ml/min, bed radius = 0.6-1.25cm when (bed length/bed radius) = 2-4 and (flow rate/bed area) = 30-400 cm/min.

Hillenbrand and Riggin (EPA 1984) more recently evaluated Tenax for the collection of volatile organics in ambient air. They found that there were no desorption problems except for acetone, and that even after sampling 580 ppb benzene for an hour at 0.5 l/min at 21°C with a trap containing 0.7g Tenax, the concentration of benzene in the exit gas was less than 5% of the concentration entering the trap.

Method TO-2, which is more applicable for highly volatile organics such as vinyl chloride which have a small breakthrough volume on Tenax, utilizes 0.4g of a carbon molecular sieve (CMS). An example of a CMS substrate is Spherocarb. The breakthrough volume at 38°C of all compounds listed in Table 29, for which method TO-2 is applicable, is in excess of 100 liters/cartridge, except for vinyl chloride, which is ≈30 liters. Sample flow rate is 20-500 ml/min. Prior to analysis, all collected samples are purged at room temperature with ≈0.5 l/min pure, dry air or nitrogen for 5 minutes to remove any collected water vapor. The sum of the sample volume and purge volume must not approach the breakthrough volume for the most volatile component of interest.

For both Tenax and CMS substrates it is recommended to collect parallel samples to check on the precision of the sampling procedure. Method TO-3 involves the use of liquid oxygen or argon which is generally not practical in the field for a large scale sampling network.

Collection efficiencies for two different sizes of Tenax trap and the GC/MS detection limits for various potential HAPs are shown in Table 31. Because of the large dilution factors associated with the ambient concentrations of volatile organics from various sources, it may be necessary to use more than one size of trap in sampling. Near the source, one liter of air through a 0.2g Tenax trap for compounds at 50ppb may be all that is required. Farther downwind, where the ambient concentrations may be 10ppb or less, 5-10 liters of air and a one gram Tenax trap may be needed to prevent breakthrough for the major compounds of interest. In order to sample for the same time period with each trap size, different flow rates would be required.

Selection of Method

In view of the selection of the site and the HAPs to be studied, the contingent requirement was that there also be a method available for the collection and analysis. There were in fact at least two available methods, the use of Tenax traps and the use of SS canisters, for the volatile C_6 to C_8 aromatics. The modelling data requirements were such that a substantial number of samples must be taken simultaneously. To do this with canisters would be much more costly for equipment than would be the use of the Tenax traps. The traps are inexpensive and expendable, and the pumps used with them are run off small batteries. In contrast, the canisters are specially fabricated and require larger pumps and a larger power supply. Re-deployment of the Tenax tube traps would be much quicker and simpler than that of the canisters, should there be a change in wind direction.

The canisters have the strong advantage that several repeat analyses may be made on the same sample, whereas the Tenax tube provides only one analysis. Although a few individual compounds (such as carbon tetrachloride) seem to offer some difficulties in

Table 31. Breakthrough Volumes in Liters for Tenax Traps and GC/MS Detection Limits for Various HAPS.

Compound	Breakthrough Volume (38°C)		GC/MS Detection Limit (ppb) †	
	Trap A	Trap B	Trap A	Trap B
Acetaldehyde	~0.7	~0.13	*Breakthru*	
Acrolein	~3	~0.6	*Breakthru*	
Aniline	~1200	~240	0.14	0.7
Benzene	19	3.8	0.16	0.8
Benzylchloride	~800	~160	0.1	0.5
Carbon Tetrachloride	8	1.6	0.08	0.4
Chlorobenzene	150	30	0.12	0.6
Chloroform	8	1.6	0.1	0.5
Chloromethylether	~150	~30	0.12	0.6
0-Dichlorobenzene	~300	~60	0.08	0.4
Ethylene dibromide	60	12	0.06	0.3
Ethylene dichloride	10	2	0.12	0.6
1,1,2-Ethylene trichloride	20	4	0.1	0.5
Methylchloride	~2	~0.4	*Breakthru*	
Methylchloroform	6	1.2	0.1	0.5
Methylene chloride	~2	~0.4	*Breakthru*	
Nitrosodimethylamine	~70	~14	0.18	0.9
Perchloroethylene	80	~16	0.08	0.4
Phenol	~360	~72	0.14	0.7
Propylene oxide	~6	~1.2	0.22	1.1
Toluene	97	19	0.14	0.7
Vinyl chloride	~0.4	~0.08	*Breakthru*	
Xylenes	~200	~40	0.12	0.6

Note: (1) Trap A contains 1 gram Tenax; sample volume = 5 liters

(2) Trap B contains 0.2 gram Tenax; sample volume = 1 liter

* Breakthrough volume is ≈ 3 times larger at 21°C than at 38°C

† Assumptions: (a) Finnegan 4023 GC/MS has detection limit of ~2.5ng for each component; and (b) 100% thermal desorption from Tenax trap

canisters, on the whole the samples appear to maintain their integrity for a reasonable length of time. Tenax tubes are difficult to clean to an acceptably low blank background level, and are reported sometimes to yield artifacts (Pellizari, et al., 1984) during thermal desorption. Both samplers would appear to be vulnerable to reaction during and after collection with other components, such as atmospheric oxidants. In canister sampling most of the oxidants are likely to be destroyed on the pump surfaces, whereas with Tenax tubes by gas-surface reactions could occur during collection, and surface reactions during and after collection. It is speculative which type of sampler would be more susceptible to this occurrence.

The final choice of Tenax tubes was made by balancing the advantages and disadvantages given, plus the prospect of obtaining canisters on loan from ASRL for co-located sampling. The Tenax tubes require only small personnel sampling pumps. Also the use of radio controlled operation was a considerable added advantage for the type of multi-site simultaneous collection that was planned. This system is described in Appendix A.

Remote Control Sampler Operation

For the field program it was necessary to obtain simultaneous samples from collection sites located over distances spanning at least one kilometer. In order to accomplish this, a system was devised to actuate battery-operated sampler tube pumps by radio control from one location. The system consists of two basic components, a hand-held transmitter and a multiple set of tripod-mounted receivers. Each receiver is wired to a variable flow rate sampling pump which can be operated either manually or by the remote control system. There are two modes of operation. In one mode, all the samplers (any number) may be actuated to go on or off simultaneously. In the other mode, up to 14 receivers may be actuated manually and independently in any order from the control center. Additional receivers may be actuated simultaneously with any of these fourteen. The receiver and sampler pumps are run off individual external rechargeable 12 volt battery packs. The receiver, pump, and battery for each unit are typically mounted on a camera tripod with the sample tube inlet at approximately 1.5m and the antenna 3.0m above ground level. The pumps are small diaphragm types such as those used for personnel or industrial safety sampling and may be preadjusted for a specific flow rate. A full description of the system design is given in Appendix A (Countess et al., 1985).

Sampling Strategy for Data to Be Used in Modelling

A table of estimated horizontal dispersions for expected values of atmospheric stabilty, various downwind distances, and a point source at ground level was prepared to be used to plan the approximate deployment of the collectors. With ten remote-controlled Tenax tube samplers available, it was intended to use two upwind, two at the edges of the most central active disposal ponds, and six deployed downwind, two of them co-located for QA/QC checks. Three downwind distances were to be used, at approximately one, two and four times a distance to be estimated from the dispersion model. The initial plan was to deploy one, three, and one collectors at the three downwind distances, respectively, one each along the estimated downwind bearing, and the other two spread laterally at the middle downwind site. The co-located sample was to be randomly placed at a source or downwind site for each run. For each field trip approximately 70-80 sealed Tenax tubes were prepared, enough for at least six runs, along with field blanks.

The canisters from ASRL, RTP, NC, could only be activated manually, two at a time, and of course used only once per field trip. It was planned to use two during each run, co-located at a different site alongside a Tenax collector tube.

The total distances to be covered, upwind to downwind extremes, were expected to be at maximum about 700-1200m.

SECTION 5

PHASE II: SAMPLING AND ANALYSIS

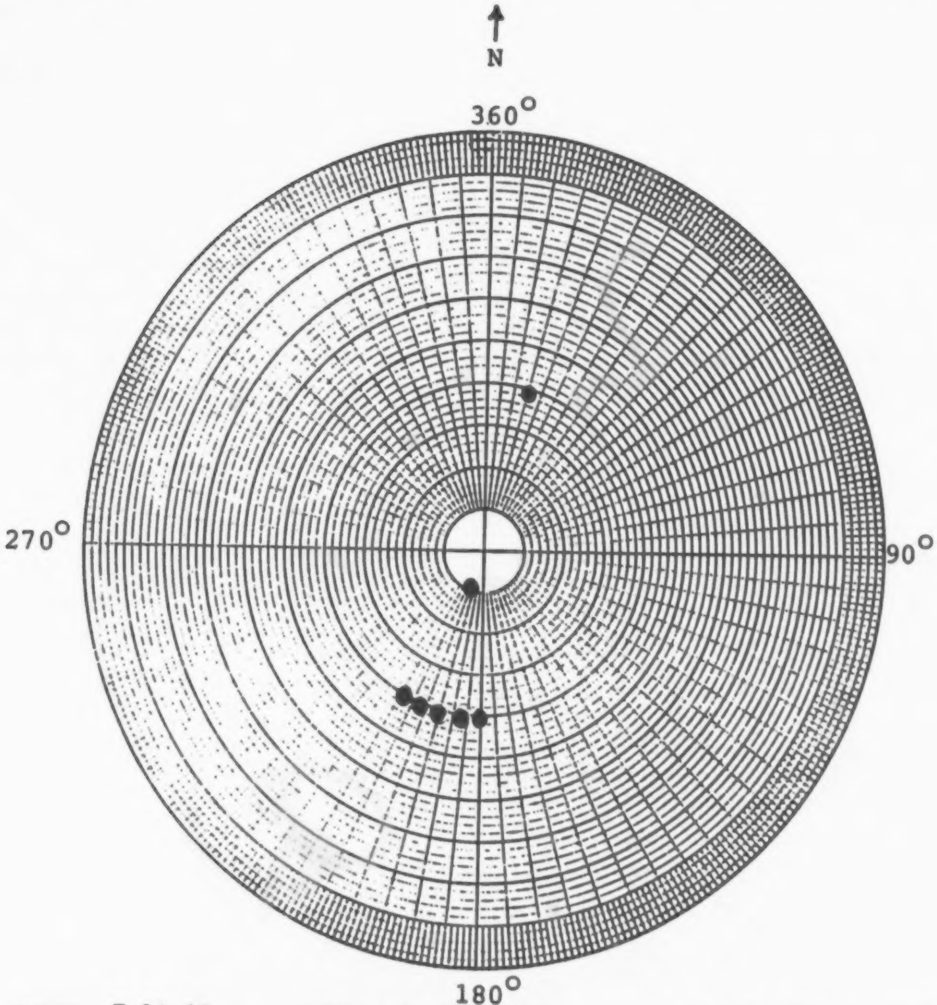
SAMPLING EPISODES

Pilot runs showed that the site was acceptable but the background levels on Tenax traps as initially conditioned were not satisfactory. Time was spent in revising the methods for the pre-treatment and storage of the Tenax tubes. This time lasted through the fall of 1984. This period and the winter following was not conducive to the field sampling program due to variable meteorology. In the spring of 1985 the landfill ownership and management had changed hands. Considerable time was spent renegotiating with the new management before it was possible to commence the field sample collection program.

The first sampling episode was conducted during the July 9 through July 11, 1985 period. Eight canisters, provided by ASRL, RTP, NC, and 27 Tenax traps were used to collect 35 samples in five 30 minute runs. The weather forecast by Engineering Science (ES) indicated favorable wind conditions for sampling. However, the winds became quite unsteady in both direction and velocity during the sampling period of July 10 and 11 into the late afternoon. The ES wind instrument malfunctioned during the sampling period; however, wind data were available from an on-site meteorological system. The system was maintained by the site management and was located on the one story roof of the facility office. The sampling days were extremely hot with temperatures remaining between 102 and 107°F during the sampling period on July 10th, and only slightly cooler on July 11th. Copies of wind, relative humidity, and temperature charts are included in Appendix G. Figures 4 to 8 show sampler locations and identifications. Bearings were taken with a compass and distances were determined with a hip chain.

The Tenax samplers were actuated simultaneously by radio control. Individual pumps supplied with the canisters allowed simultaneous collection of two canister samples at a time. These samples were taken manually and coincident with the Tenax trap samples. The trap pumps were preadjusted to collect three liters of air in 30 minutes, and the canister pumps were preadjusted to reach 20 psi in that period, starting with canisters evacuated to about 1 Torr. The canister pressures dropped later when they cooled down.

At the central laboratory, previous to the field work, the Tenax traps were purged in the heated manifold with pure nitrogen and sealed on both ends with a torch. A few were analyzed to verify their cleanliness. In the field the tips of the tubes were broken off on each end shortly before insertion into the

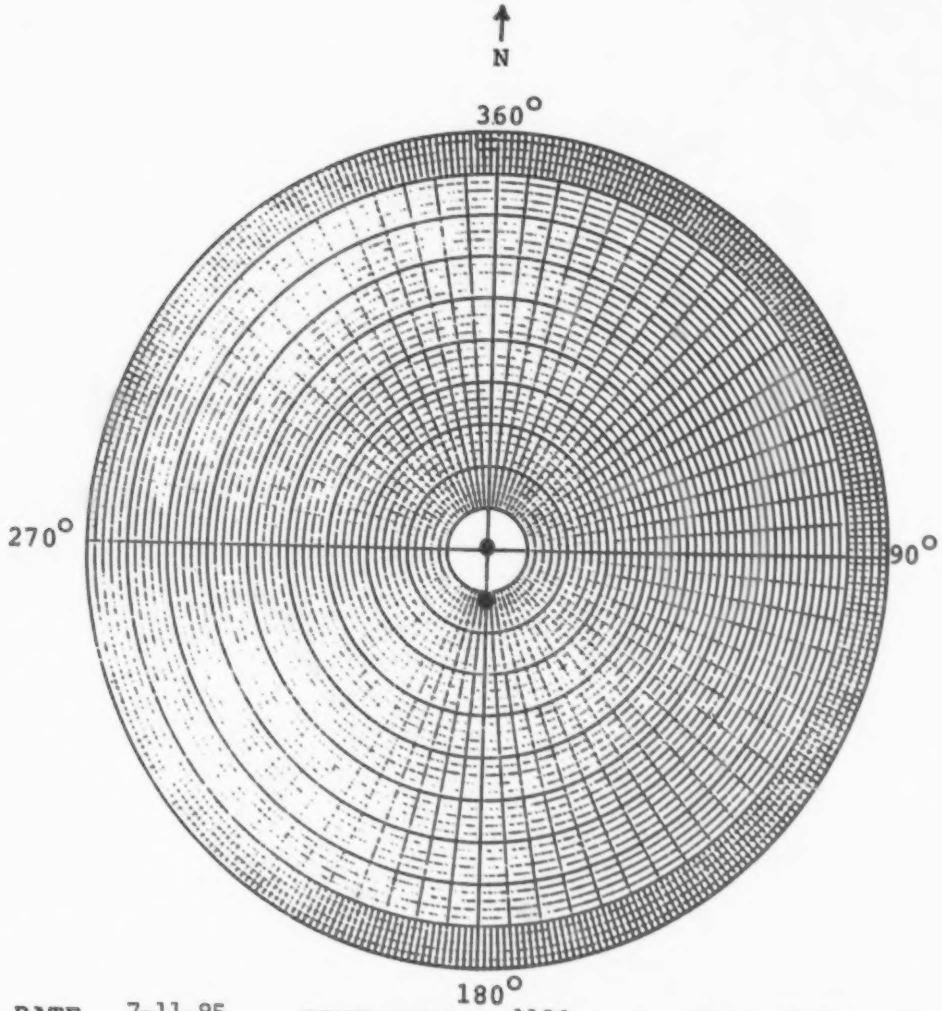


DATE 7-10-85 TIME START 1830 TIME STOP 1900

Center reference point is light pole near washup area. Each major division represents 50 yds., radius of outer circle is 500 yds.

Canister Nos.	Tenax tube Nos.	Distance from Reference	Direction from Reference
None	T1	200 yd.	15°
	T2	on site	---
	T3	50 yd.	195°
	T5	200 yd.	181°
	T6	200 yd.	188°
	T8	200 yd.	195°
	T9	200 yd.	202°
	T10	200 yd.	209°

Figure 4. Polar charts with sample site locations, first episode.

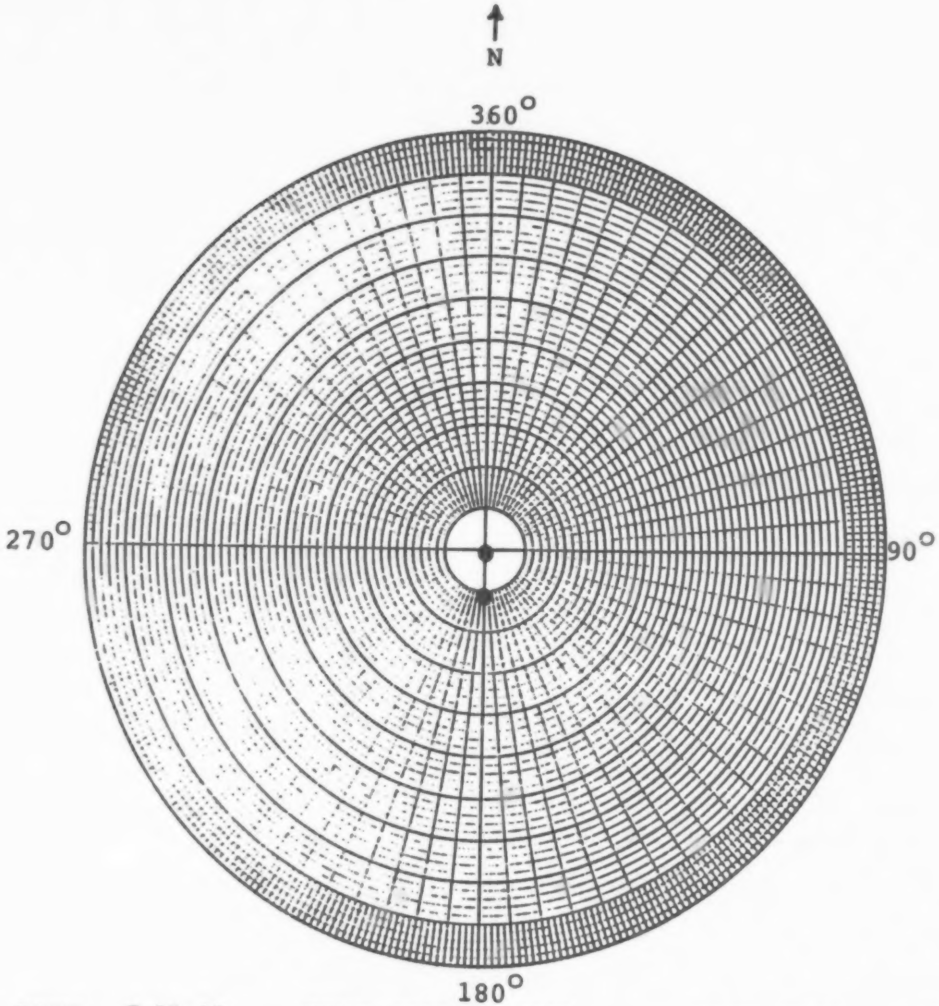


DATE 7-11-85 TIME START 1136 TIME STOP 1221

Center reference point is light pole near washup area.
Each major division represents 50 yds., radius of outer circle is 500 yds.

Canister Nos.	Tenax tube Nos.	Distance from Reference	Direction from Reference
12	---	on site	---
10	---	on site	---
	T11	on site	---
	T12	on site	---
	T13	60 yd.	180°
	T14	60 yd.	180°

Figure 5. Polar charts with sample site locations, first episode.

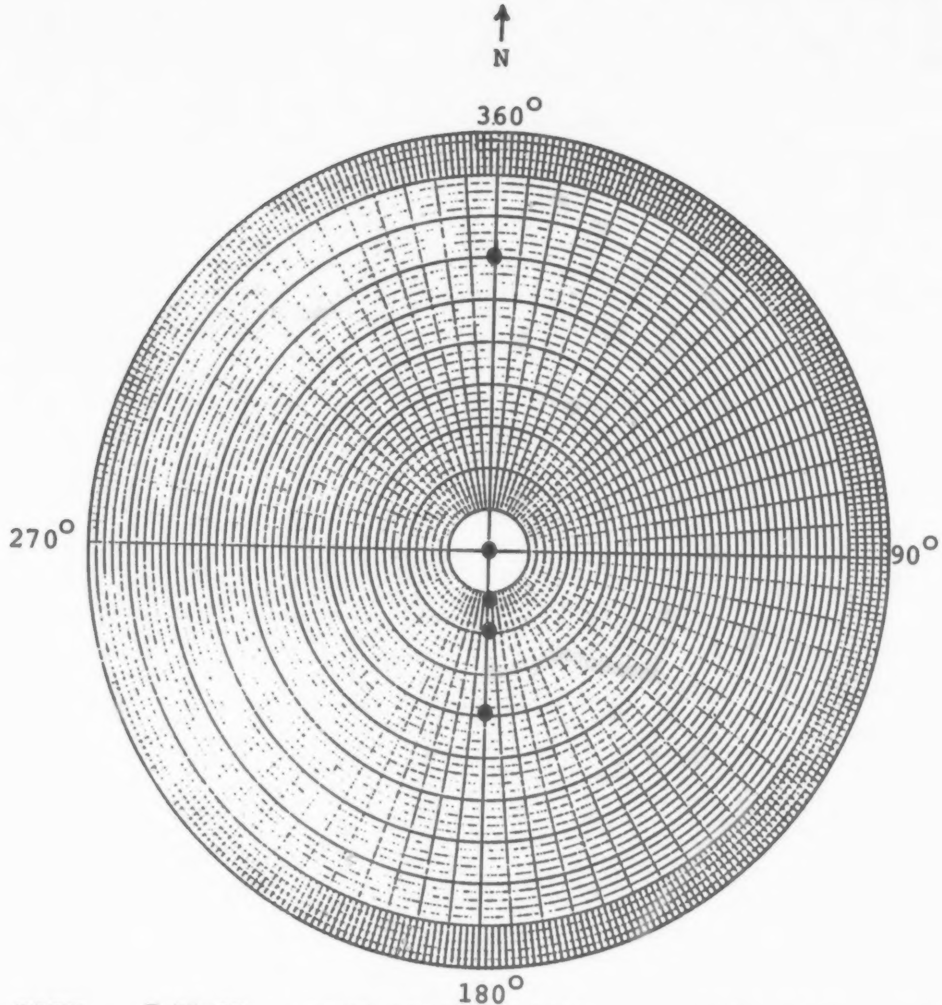


DATE 7-11-85 TIME START 1250 TIME STOP 1320

Center reference point is light pole near washup area.
Each major division represents 50 yds., radius of outer circle is 500 yds.

Canister Nos.	Tenax tube Nos.	Distance from Reference	Direction from Reference
C6	---	on site	---
C9	---	on site	---
	T15	on site	---
	T16	on site	---
	T17	60 yd.	180°
	T18	60 yd.	180°

Figure 6. Polar charts with sample site locations, first episode.

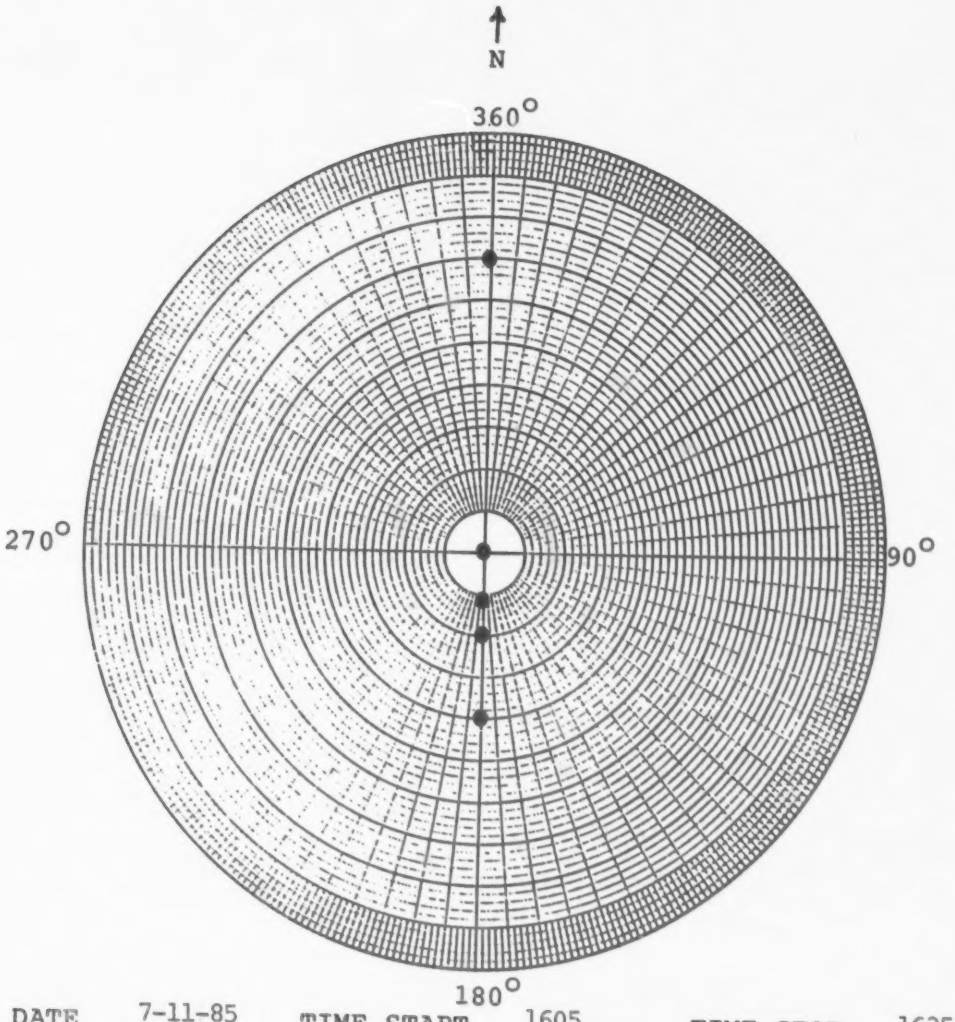


DATE 7-11-85 TIME START 1431 TIME STOP 1501

Center reference point is light pole near washup area. Each major division represents 50 yds., radius of outer circle is 500 yds.

Canister Nos.	Tenax tube Nos.	Distance from Reference	Direction from Reference
C7	---	352 yd.	360° (=0°)
C11	---	352 yd.	360°
	T21	352 yd.	360°
	T22	352 yd.	360°
	T24	on site	---
	T25	60 yd.	180°
	T26	100 yd.	180°
	T27	200 yd.	180°

Figure 7. Polar charts with sample site locations, first episode.



DATE 7-11-85 TIME START 1605 TIME STOP 1635

Center reference point is light pole near washup area.
Each major division represents 50 yds., radius of outer circle is 500 yds.

Canister Nos.	Tenax tube Nos.	Distance from Reference	Direction from Reference
C4	---	352 yd.	360° (=0°)
C2	---	352 yd.	360°
	T28	352 yd.	360°
	T29	352 yd.	360°
	T30	on site	---
	T31	on site	---
	T32	60 yd.	180°
	T33	100 yd.	180°
	T34	200 yd.	180°

Figure 8. Polar charts with sample site locations, first episode.

sampler inlet holder. Immediately after sampling each tube was resealed on both ends with a propane microtorch and returned to the central laboratory for analysis. The GC analyses were commenced within one day of the arrival of samples at the laboratory and continued without interruption. Each canister was sampled by passing three liters of sample gas from it through a clean Tenax tube. Total volume collected was determined by water displacement downstream.

Results of the GC analyses run by GGC are given in Tables 32 and 33. Table 32 lists results of Tenax tube collection and analyses for the six hydrocarbons from benzene to o-xylene. Table 33 gives results of GGC analysis of aliquots removed from canisters into Tenax tubes. Replication data, including analyses of the same canisters by ASRL, RTP, NC, are given in the QC/QA covered in Appendix A.

The second site sampling study was performed during the September 4 and September 5, 1985 period. Although the meteorological forecast was favorable for the study on September 4, an unforeseen air mass from the south altered the stable conditions substantially. The altered, generally unstable conditions persisted through most of September 5. Although six canister samples were taken for compositional information, the wind was never stable enough to warrant setting out the array of Tenax tube collectors until early evening. A period of steady consistent wind persisted long enough to obtain one sampling set at 1910-1940 hours, with two canisters collected on site at 1910-1930 hours. Unfortunately one sampler malfunctioned, so that only nine samples were obtained.

The polar plots with sampling data are given in Figures 9 to 12. The GC analyses of these tubes and eight canisters are shown in Table 34. Replicate and co-location data are shown in Appendix A. As in the previous episode, a summary of the results using capillary GC, from ASRL, RTP, NC, are given in that Appendix. The complete computer printouts of all GC peaks observed by ASRL are also included.

Prior to the third sampling episode, six additional remote samplers were obtained, allowing for a total of sixteen samplers in the grid. Fifteen canisters were also borrowed again from ASRL, with two pumps. The sampling methodology was revised to reflect the experience by ASRL; the canisters were first flushed with the outside air with both valves open, one valve was closed, and then the canister was pumped up to the recommended final pressure as fast as the pump allowed, and closed off. The canister runs were made independently of the Tenax cartridge runs. One other improvement was the addition of an integrating wind instrument to provide short term readout of integrated air movement.

Table 32. Analyses of Tenax tubes from the Taft site, first episode

		Mass (ng)					Concentration (ppbV) @ 25°C				
Sample Group	Trap#	Benzene	Toluene	Ethyl Benzene	p+m- Xylenes	o- Xylene	Benzene	Toluene	Ethyl Benzene	p+m- Xylenes	o- Xylene
I	1	2.0	ND(b)	ND	ND	ND	0.30	ND	ND	ND	ND
	2	32.6	59.1	16.2	50.0*	10.3	3.48	5.35	1.27	4.56*	1.44
	3	29.5	65.6	31.7	88.4*	38.9	3.15	5.94	2.49	6.95*	3.06
	4	40.1	58.7	11.5	33.2*	11.7	4.28	5.32	0.90	2.61*	0.92
	5	15.0	28.3	6.9	21.7*	6.7	1.60	2.56	0.54	1.71*	0.53
	6	15.0**	28.0	4.1	8.4	1.8	[1.60**]	2.53	0.32	0.66	0.14
	7	---	---	---	---	---	---	---	---	---	---
	8	3.9	21.3*	2.9	5.0*	2.1	0.42	[1.93**]	0.23	0.39*	0.17
	9	65.1	58.5	15.9	40.1*	16.2	6.96	5.30	1.25	3.15*	1.27
	10	3.6	19.3	8.5	15.1*	8.3	0.38	1.75	0.67	1.19*	0.65
II	11	50.7	210.9	54.3	175.4*	60.9	5.42	19.10	4.27	13.79*	4.79
	12	56.8	260.1	115.0	318.5*	144.9	6.07	23.56	9.04	25.04*	11.39
	13	33.0*	318.0**	82.0**	264.0**	94.0**	3.53*	[28.80**]	[6.45**]	[20.75**]	[7.39*]
	14	29.6*	211.9	80.2	242.1*	97.0	3.16*	19.19	6.31	19.03*	7.63
III	15	36.0*	151.7	92.9	247.2*	127.8	3.85*	13.74	7.25	19.43*	10.04
	16	50.0**	221.8	80.4	274.7*	128.7	[5.34**]	20.09	6.29	21.59*	10.11
	17	17.4*	63.0	10.0**	40.0*	20.0**	1.86*	5.71	[0.79**]	[3.14**]	[1.57**]
	18	14.1*	46.0	10.9*	33.3*	11.4	1.51*	4.17	0.86*	2.62*	0.90
	19	ND	ND	ND	ND	ND	Method	Blank	---	---	---
	20	25.9	49.8	124.1*	121.1*	44.2	25.2	41.01	88.69*	86.55*	31.59
IV	21	3.8	5.9	ND	4.2	ND	0.41	0.53	ND	0.33	ND
	22	3.4	4.7	***	***	***	0.36	0.43	[***]	[***]	[***]
	23	17.7*	73.7	20.6	107.3*	25.5	1.89*	6.68	1.62	8.44*	2.08
	24	---	---	---	---	---	---	---	---	---	---
	25	28.0*	93.5	57.8	143.3*	72.6	2.99*	8.47	4.54	11.27*	5.71
	26	15.1*	67.7	86.5	78.5*	42.4	1.61*	6.13	6.80	6.17*	3.33
	27	10.1*	27.0	***(a)	***(a)	***(a)	1.08*	2.45		[Σ = 15.53]	
V	28	4.0	8.3	ND	3.5*	1.2	0.43	0.75	ND	0.28*	0.09
	29	4.8	9.9	2.8	10.6*	3.3	0.51	0.90	0.22	0.83*	0.26
	30	35.9	207.4	60.3	217.9*	73.8	3.84	18.79	4.74	17.13*	5.80
	31	64.1	233.9	93.2	295.4*	122.3	6.85	21.19	7.33	23.22*	9.61
	32	13.9	88.2	26.2	90.2*	28.9	1.49	7.99	2.06	7.09*	2.27
	33	6.3	30.8	9.5	32.6*	9.4	0.67	2.79	0.75	2.56*	0.74
	34	3.0**	13.4	5.0**	15.0**	4.0*	[0.32**]	1.21	[0.39**]	[1.18**]	0.31
	35	1.0**	1.5	ND	ND	ND	[0.11**]	0.14	ND	ND	ND
	36	1.1	ND	ND	ND	ND	0.11	ND	ND	ND	ND

Note: 1. Trap #19 was the method blank.

2. Trap #20 was the duplicate of canister #10, but the sample volume was 10% of trap #T.

3. Traps #13 & #14 were duplicates; Canister #12 & 10; #6 & 9; #7 & 11; #4 & 2 are replicates. #11 & 12 were duplicates; #15 & 16; #17 & 18 were duplicates. #21 & 22; #30 & 31 were duplicates.

4. Traps #28 & 29 were field blanks.

* Overlapped Peaks, or unresolved peaks

** Estimation due to poor peak shapes or inappropriate integration

*** Cannot be estimated

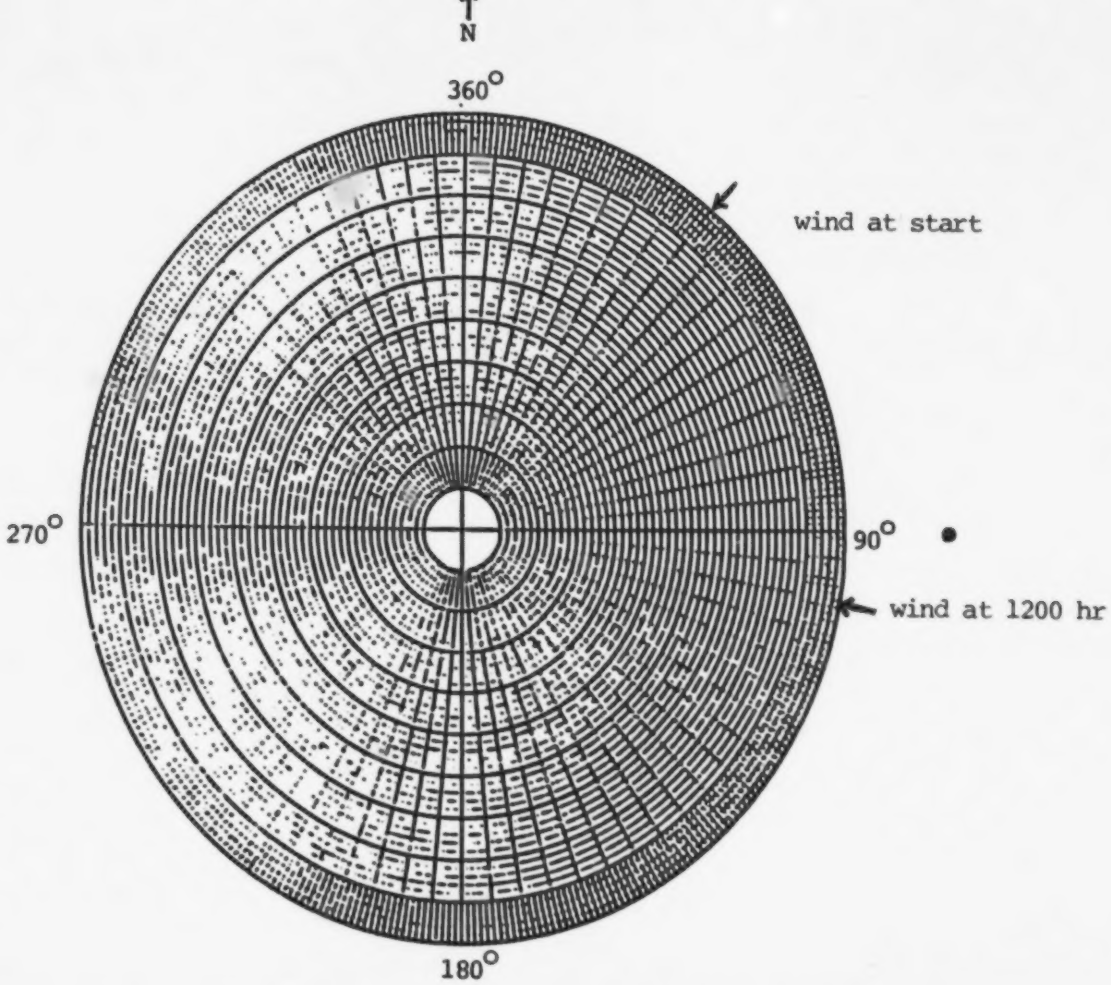
(a) Total xylenes 197.5 ng (est)

(b) ND: not detected

Table 33. Analyses of Canisters from the Taft site first episode
by Aliquot Removal into Tenax Traps

	Mass (ng)					Concentration (ppbV) @ 25°C				
Can#	Benzene	Toluene	Ethyl Benzene	p+m-Xylenes	o-Xylene	Benzene	Toluene	Ethyl Benzene	p+m-Xylenes	o-Xylene
2	51.8	59.2	210.9*	59.1*	24.7	5.53	5.36	16.58*	4.65*	1.94
4	41.3	42.3	9.4	45.4*	16.6	4.34	3.77	0.73	3.52*	1.29
6	53.5	183.3	37.1	210.8*	60.4	5.72	16.60	2.92	16.57*	4.75
9	91.7	218.7	95.3	267.9*	147.9	11.10	22.43	8.48	23.84*	13.16
7	40.3	28.2	130.9*	27.0**	30.0**	4.32	2.55	10.29*	[2.12**]	[2.36**]
11	27.8	20.2	135.9	20.0	29.7	2.97	1.83	10.68	1.57	2.33
10	80.3	341.9	186.0*	463.7**	200.0	8.58	30.97	14.62*	[36.45**]	15.72
12	44.1	247.7	130.0**	373.8*	189.1*	4.71	22.44	[10.22**]	29.34*	14.87*

See footnotes Table 32

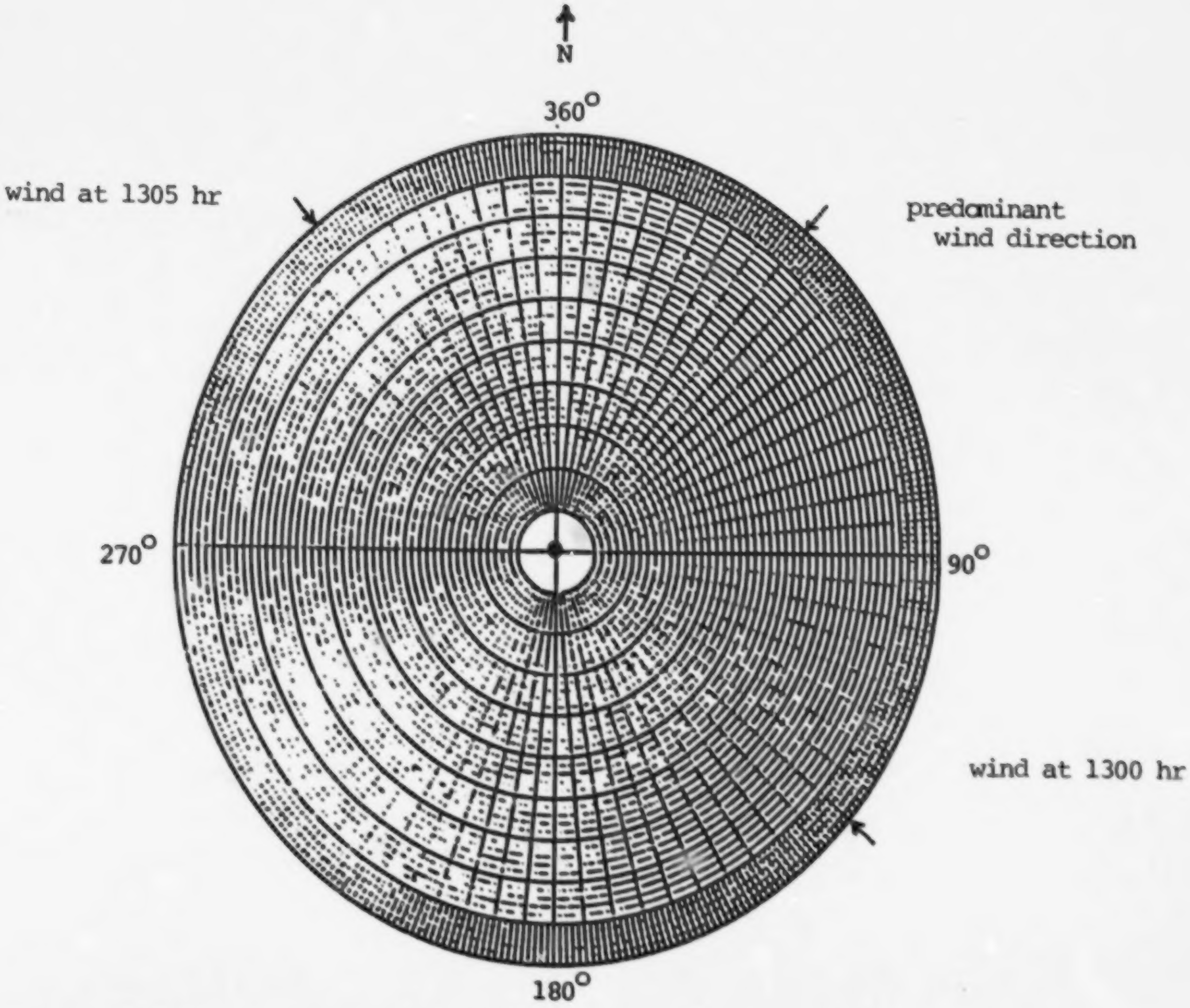

N
360°
wind at start
270°
90°
wind at 1200 hr
180°

DATE 9-5-85 TIME START 1130 TIME STOP 1200 (#3); 1210(#4)

Center reference point is West end of ww3.
Each major division represents 50 yds., radius of outer circle is 500 yds.

Canister No.	Tenax tube Nos.	Pressure,start	Pressure,end	Distance	Direction
4	---	29.5 in Hg vac	10 psi	600 yd.	90°
3	---	28.5 in Hg vac	10.5 psi	600 yd.	90°

Figure 9. Polar charts with sample site locations, second episode.


N
360°
wind at 1305 hr
predominant wind direction
270°
90°
wind at 1300 hr
180°

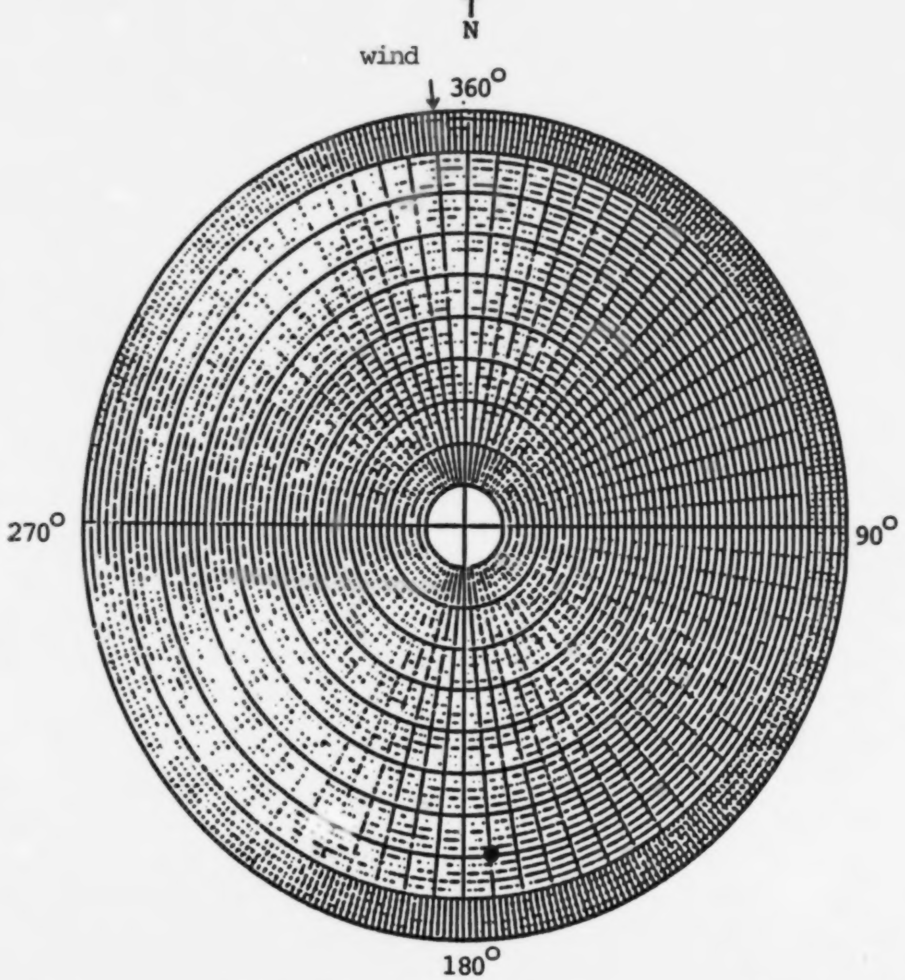
DATE 9-5-85 **TIME START** 1245 **TIME STOP** 1315

Center reference point is West end of ww3.
Each major division represents 50 yds., radius of outer circle is 500 yds.

Canister No.	Tenax tube Nos.	Pressure,start	Pressure,end	Distance	Direction
ARB6	---	26 in Hg vac	12 psi	on site	---
2	---	28 in Hg vac	10.5 psi	on site	---

ARB6 reserved for GC/MS by ARSL

Figure 10. Polar charts with sample site locations, second episode.

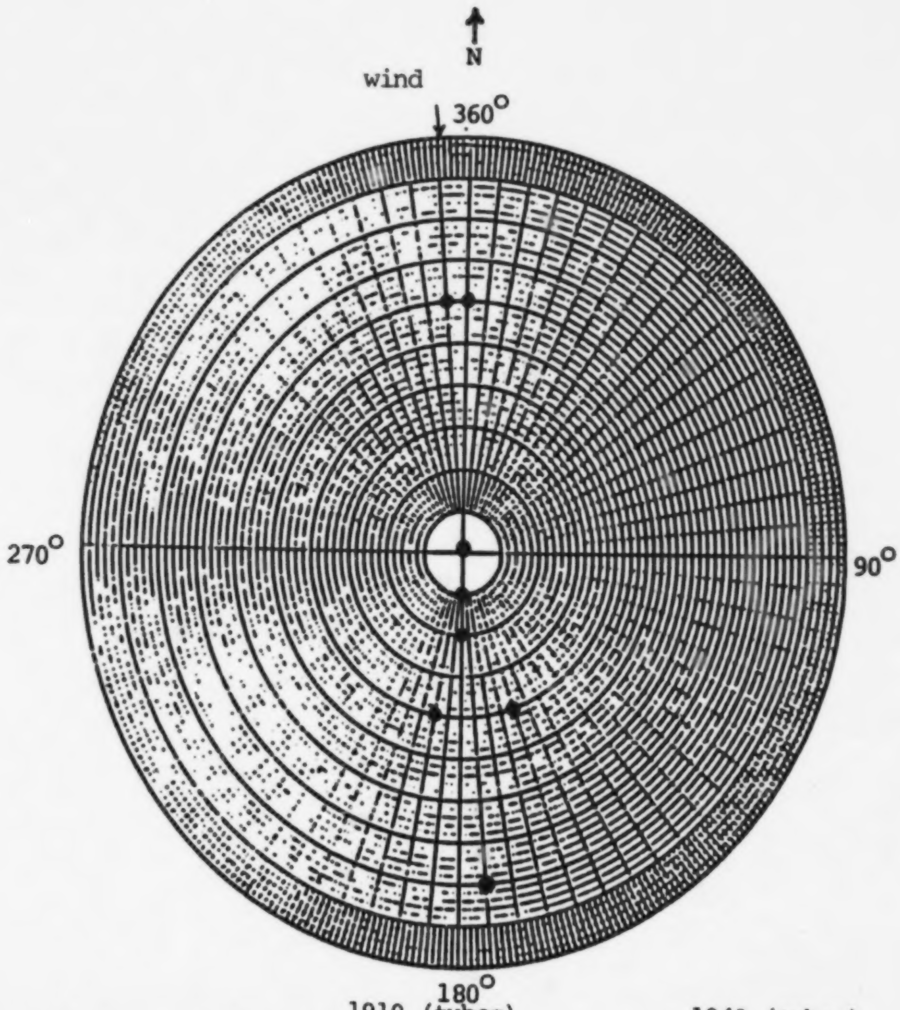


DATE 9-5-85 TIME START 1720 TIME STOP 1750

Center reference point is oil pond north of light poles
Each major division represents 50 yds., radius of outer circle is 500 yds.

Canister No.	Tenax tube Nos.	Pressure,start	Pressure,end	Distance	Direction
ARB9	---	25 in Hg vac	9.5 psi	400 yd.	175°
10	---	29.5 in Hg vac	10.5 psi	400 yd.	175°

Figure 11. Polar charts with sample site locations, second episode.



DATE 9-5-85 TIME START 1910 (tubes) 1900 (cans) TIME STOP 1940 (tubes) 1930 (cans)

Center reference point is south edge of large oil pond.
Each major division represents 50 yds., radius of outer circle is 500 yds.

Canister No.	Tenax tube Nos.	Pressure,start	Pressure,end	Distance	Direction
6	---	30 in Hg vac	10 psi	on site	---
7	---	29 in Hg vac	10 psi	on site	---
	37			400 yd.	175°
	38			200 yd.	160°
	40			200 yd.	190°
	41			100 yd.	180°
	42			on site	---
	43			300 yd.	355°
	44			300 yd.	360°
	45			50 yd.	180°

Figure 12. Polar charts with sample site locations, second episode.

Table 34. Analyses of Tenax tubes from Taft site, second episode (9-5-85)

	Mass (ng)						Concentration (ppb V) @ 25°C					
Trap#	Benzene	Toluene	Ethyl-Benzene	p-Xylene	m-Xylene	o-Xylene	Benzene	Toluene	Ethyl-Benzene	p-Xylene	m-Xylene	o-Xylene
						Tenax Traps						
37	9.27	27.62	8.00	6.83	20.76	7.85	1.01	2.56	0.64	0.55	1.67	0.63
38(a)												
39	35.39	59.91	23.06	18.64	63.12	28.53	3.39	4.86	1.62(b)	1.31	4.44	2.01
40	21.70	15.83	5.29	4.72	13.52	6.10	2.12	1.31	0.38(b)	0.34	0.98	0.44
41	62.07	146.40	57.40	48.95	164.98	81.02	6.54	13.09	4.45	3.80	12.80	6.29
42	3984.18	529.68	290.60	(b)	61.87	46.69	434.35(b)	48.96	23.30(b)	*(b)	4.96	3.75
43	10.65	2.05	0.94	ND	1.47	0.36	1.13	0.18	0.07	ND(c)	0.11	0.03
44	10.55	2.58	ND	ND	0.63	ND	1.13	0.23	ND	ND	0.05	ND
45	16.44	34.66	18.14	14.52	50.62	20.86	1.71	3.05	1.38	1.11	3.86	1.59
						Canisters						
46	20.97	13.60	74.24	(b)	9.47	17.73	2.24	1.23	5.84(b)	(b)	0.74	1.39
47	35.48	17.40	78.90	(b)	22.55	17.28	3.97	1.58	6.20(b)	(b)	1.77	1.36
48	54.56	80.68	72.43	22.03	44.85	27.17	5.83	7.31	5.69	1.73	3.53	2.14
49	44.01	81.34	115.60	20.96	45.47	18.91	4.70	7.37	9.09(b)	1.65	3.57	1.49
50(d)	27.43	11.73	14.41	3.78	12.13	4.51	8.79	3.19	3.40(b)	0.89	2.86	1.06
51(d)	18.53	6.96	31.33	ND	9.65	3.58	5.94	1.89	7.39(b)	ND	2.28	0.84
52(d)	15.78	10.59	52.09	ND	4.94	3.22	5.06	2.88	12.29(b)	ND	1.17	0.76
53(d)	9.80	5.02	25.77	ND	6.79	3.33	3.14	1.36	6.08(b)	ND	1.60	0.79

(a) Sample lost

(b) Overlapped peaks or unresolved peaks

(c) ND Not detected

(d) One liter of air sample was preconcentrated on Tenax trap prior to analysis by GGC/PID
(Analytical Replicates from the same canister)

The third episode sampling was done in the period of May 22 to May 25, 1986. The disposal site was not in active use during this period, although the ponds were still emitting vapors. There was limited vehicle traffic and consequently limited vehicular emissions. There was a shop area inside the facility, where vehicles were being repaired. The conditions were favorable except for two runs where the wind direction was more variable than desired. During the four day period, three canister runs were made with five canisters each deployed up and down the expected line of wind direction without lateral (sigma y) deployment. Eight runs were made with the network of Tenax cartridges with one "upwind", one "source", and four "downwind" distances, and the additional samplers located laterally in various orientations that differed from run to run. The nominal upwind and downwind directions were not always maintained during the actual sampling because of wind shifts. The fact that the area north of the site was not accessible to sampler location restricted sampling to the southern side. Fortunately, the wind direction was predominantly from the northern side.

The polar plots with sampler locations, identification numbers, and wind data are shown in Figures 13 through 23. Figures 13 to 15 are canister runs, while Figures 16 to 23 are Tenax cartridge runs. Results of canister GC analyses at GGC (by aliquot removal via Tenax tubes) are given in Table 35, and results of GC analyses of Tenax field cartridges are given in Tables 36 through 43. Comparisons of the GGC canister analyses with the direct canister GC analyses provided by ASRL are included in Appendix A. Colocation and replicate data are also summarized there.

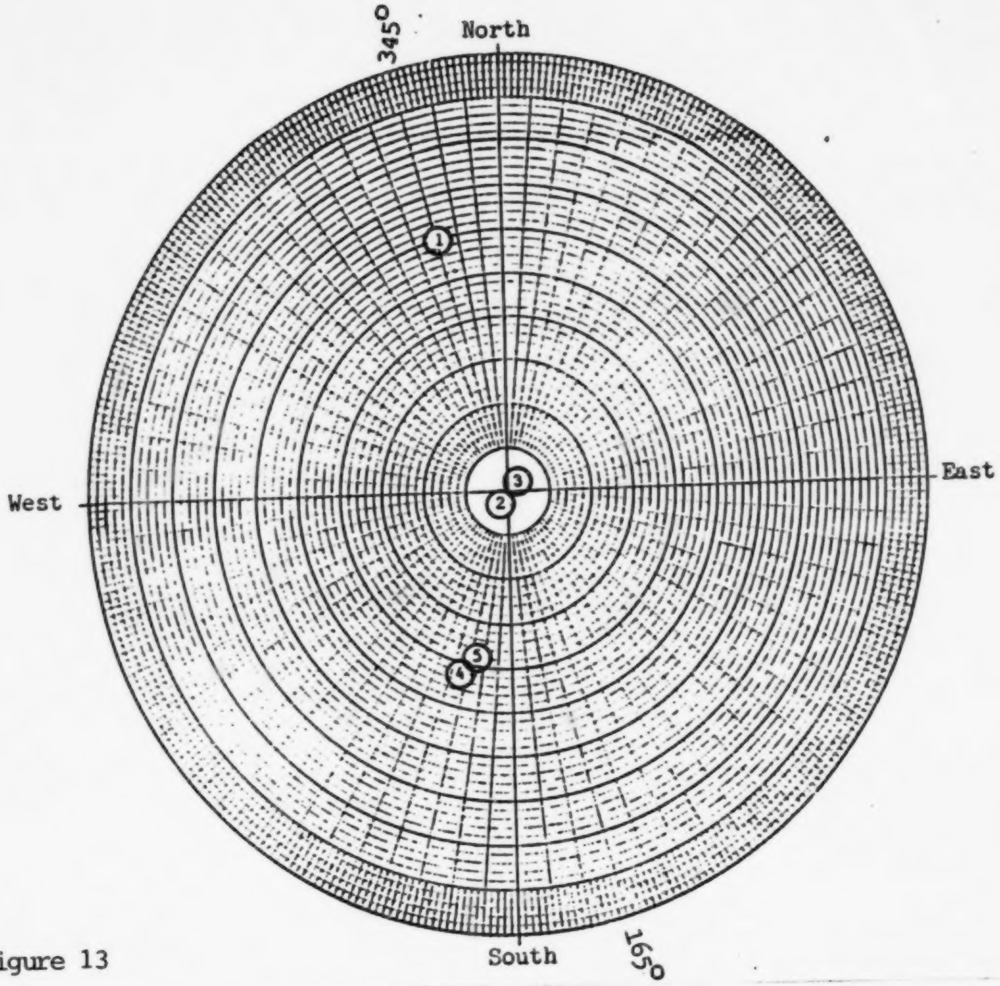


Figure 13

DATE 5-22-86

CANISTER #	SAMPLE TIME	LOCATION RELATIVE TO SOURCE DISTANCE, YDS	DIRECTION, °
1	1140-1150	300	345
2	1200-1210	0	SOURCE
3	1212-1230	0	SOURCE
4	1235-1254	200	195
5	1256-1311	200	195

WIND DATA

TIME	TEMP°C	WIND DIR.	STD.DEV., °	WIND VEL., m/s
1140	17.5	189		0.80
1145	18.7	024		1.62
1150	18.4	014		1.65
1155	18.6	039		2.45
1200	18.2	051		0.80
1205	19.0	354		1.12
1210	18.9	089		2.85
1215	19.0	062		1.02
1220	18.9	326		2.02
1225	19.0	341		1.17
1230	19.4	021		2.57
1235	19.4	014		2.10
1240	19.3	002		0.80
1245	19.7	136		0.72
1250	20.0	088		2.25
1255	20.0	028		1.97
1300	20.1	349		2.45
1305	19.6	059		1.30
1310	20.0	022		2.55
1130-1200	18.2	034	78.3	1.12
1200-1230	19.0	024	62.3	1.25
1230-1300	19.8	031	70.0	1.25
1300-1330	20.0	000	63.2	1.62

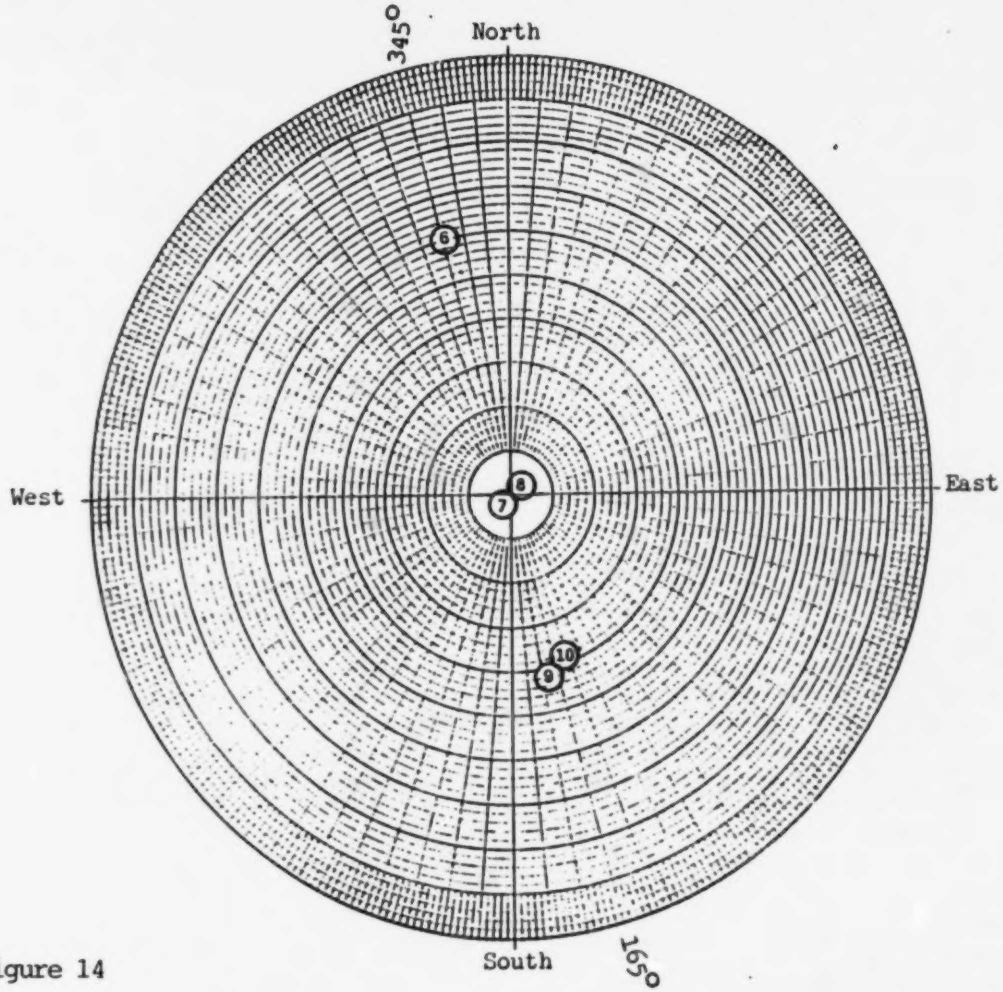


Figure 14

DATE 5-22-88

CANISTER #	SAMPLE TIME	LOCATION RELATIVE TO SOURCE DISTANCE, YDS	 DIRECTION, °
6	2003-2013	300	345
7	1947-1957	0	SOURCE
8	1936-1946	0	SOURCE
9	1921-1931	200	165
10	1911-1921	200	165

WIND DATA

TIME	TEMP°C	WIND DIR.	STD.DEV.,°	WIND VEL.,m/s
1915	20.8	338		2.17
1920	20.6	336		2.22
1925	20.6	341		2.02
1930	20.5	360		1.52
1935	20.4	022		1.42
1940	20.2	017		1.42
1945	19.8	073		1.22
1950	19.4	116		1.17
1955	19.2	112		1.32
2000	18.9	093		1.62
2005	18.8	096		2.07
2010	18.0	117		1.07
2015	17.8	125		1.00
1900-1930	20.7	344	17.5	1.92
1930-2000	19.6	073	43.3	1.05
2000-2030	17.8	123	27.0	1.05

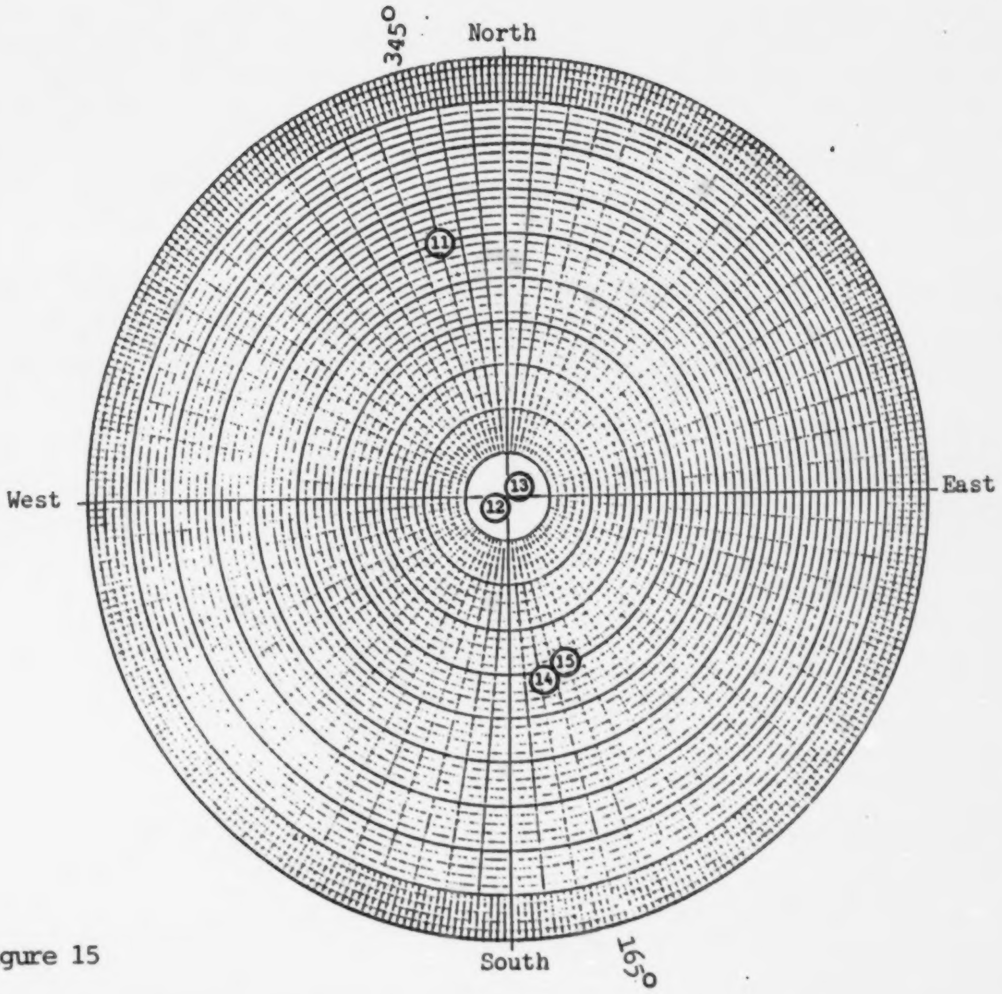


Figure 15

DATE 5-23-86

CANISTER #	SAMPLE TIME	LOCATION RELATIVE TO SOURCE	
		DISTANCE, YDS	DIRECTION, °
11	0944-0954	300	345
12	0832-0840	0	SOURCE
13	0842-0852	0	SOURCE
14	0917-0927	200	165
15	0928-0938	200	165

WIND DATA

TIME	TEMP°C	WIND DIR.	STD.DEV.,°	WIND VEL.,m/s
0835	17.5	313		3.85
0840	17.9	314		3.87
0845	17.9	325		3.77
0850	18.2	333		3.72
0855	18.2	339		3.80
0900	18.3	327		3.80
0905	18.7	341		3.35
0910	18.9	337		3.50
0915	18.8	350		3.72
0920	19.0	333		3.67
0925	19.4	359		3.27
0930	19.2	345		3.32
0935	19.5	344		3.27
0940	19.4	354		3.72
0945	19.6	002		2.85
0950	20.0	007		2.77
0955	19.8	017		2.85
0830-0900	18.0	325	14.8	3.70
0900-0930	19.0	343	18.1	3.45
0930-1000	19.7	359	21.9	2.90

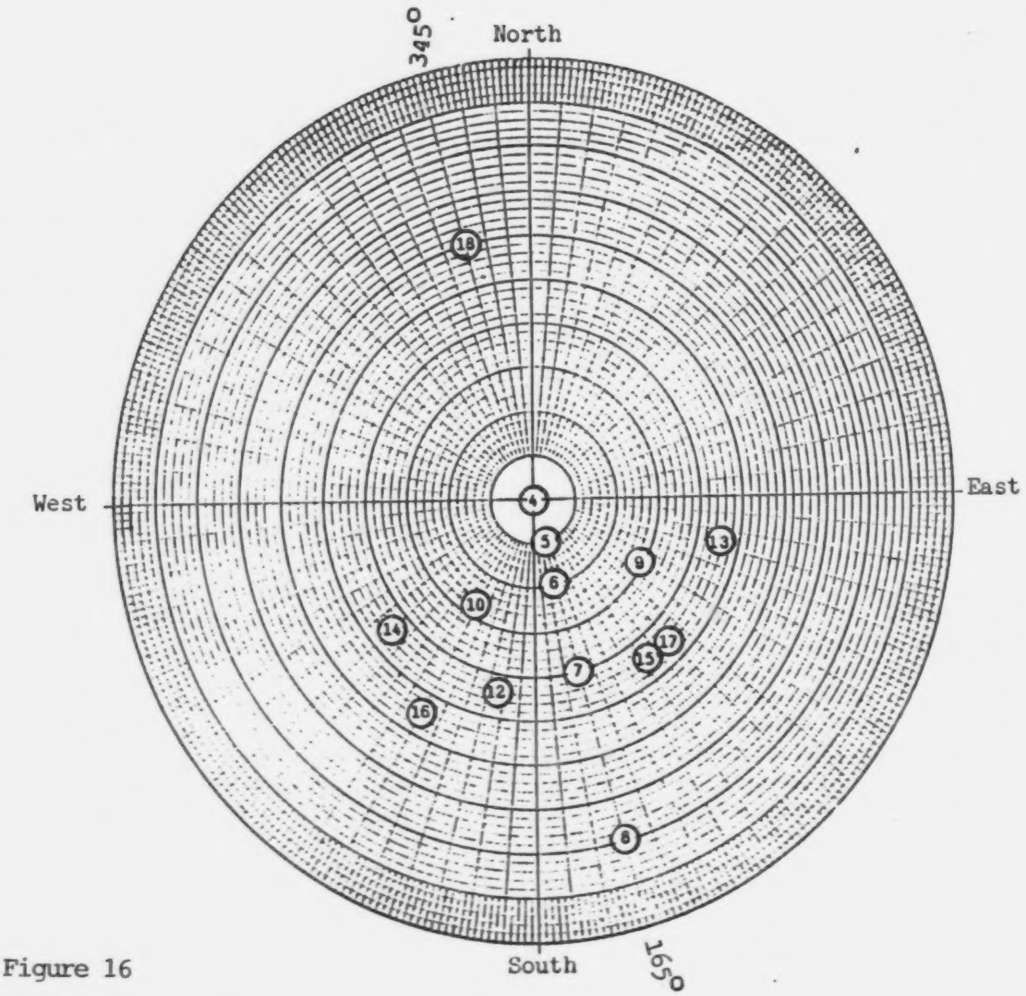


Figure 16

DATE 5-20-86 START TIME 1855 STOP TIME 1925

TUBE #	AIR VOLUME, L	LOCATION		
		DIR.,°	YDS TO SOURCE	LATERAL YDS
T-18	---	345	300	0
T-4	3.00	0	SOURCE	0
T-5	3.09	165	50	0
T-14	2.93	165	100	200 W
T-10	3.14	165	100	100 W
T-6	3.19	165	100	0
T-9	3.11	165	100	100 E
T-13	2.95	165	100	200 E
T-16	3.01	165	200	200 W
T-12	2.92	165	200	100 W
T-7	3.18	165	200	0
T-15	2.55	165	200	100 E
T-17	2.76	165	200	DUP 100 E
T-8	2.43	165	400	0

WIND DATA

TIME	TEMP°C	WIND DIR.	STD.DEV.,°	WIND VEL.,m/s
1900	25.4	261		7.35
1905	25.2	265		7.72
1910	24.9	262		7.55
1915	24.8	260		7.20
1920	24.6	259		7.25
1925	24.4	257		6.60
1830-1900	26.3	266	8.0	7.4
1900-1930	24.7	260	7.0	7.17

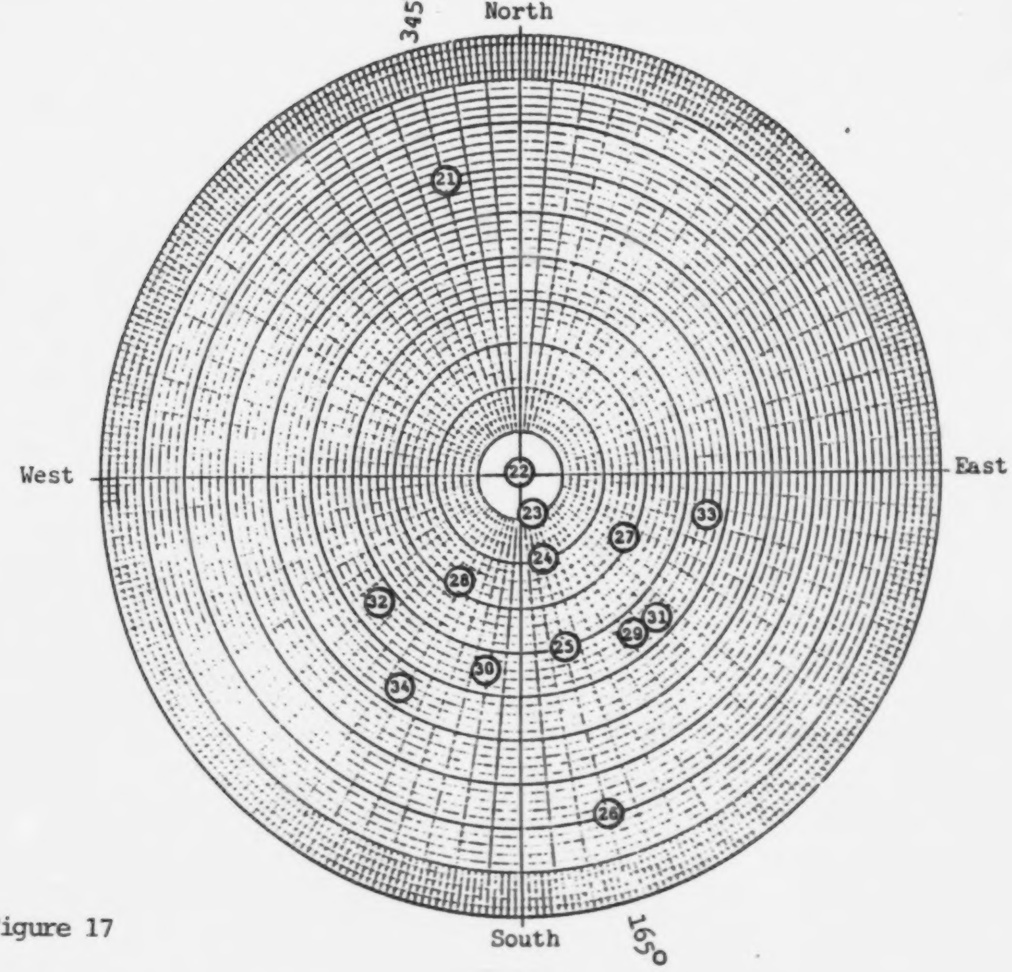


Figure 17

DATE 5-21-86 START TIME 1145 STOP TIME 1218

TUBE #	AIR VOLUME, L	DIR., °	LOCATION YDS TO SOURCE	LATERAL YDS
T-21	2.81	345	300	0
T-22	2.89	0	SOURCE	0
T-23	2.78	165	50	0
T-32	2.43	165	100	200 W
T-28	2.96	165	100	100 W
T-24	2.72	165	100	0
T-27	3.12	165	100	100 E
T-33	2.62	165	100	200 E
T-34	2.88	165	200	200 W
T-30	2.07	165	200	100 W
T-25	3.29	165	200	0
T-29	3.23	165	200	100 E
T-31	3.11	165	200	DUP 100 E
T-26	3.00	165	400	0

WIND DATA

TIME	TEMP°C	WIND DIR.	STD.DEV.,°	WIND VEL.,m/s
1150	16.2	328		2.80
1155	15.9	318		3.85
1200	16.0	031		1.60
1205	16.7	004		2.42
1210	16.9	062		2.62
1215	17.0	024		3.40
1130-1200	16.1	328	43.3	3.12
1200-1230	16.9	010	47.4	2.10

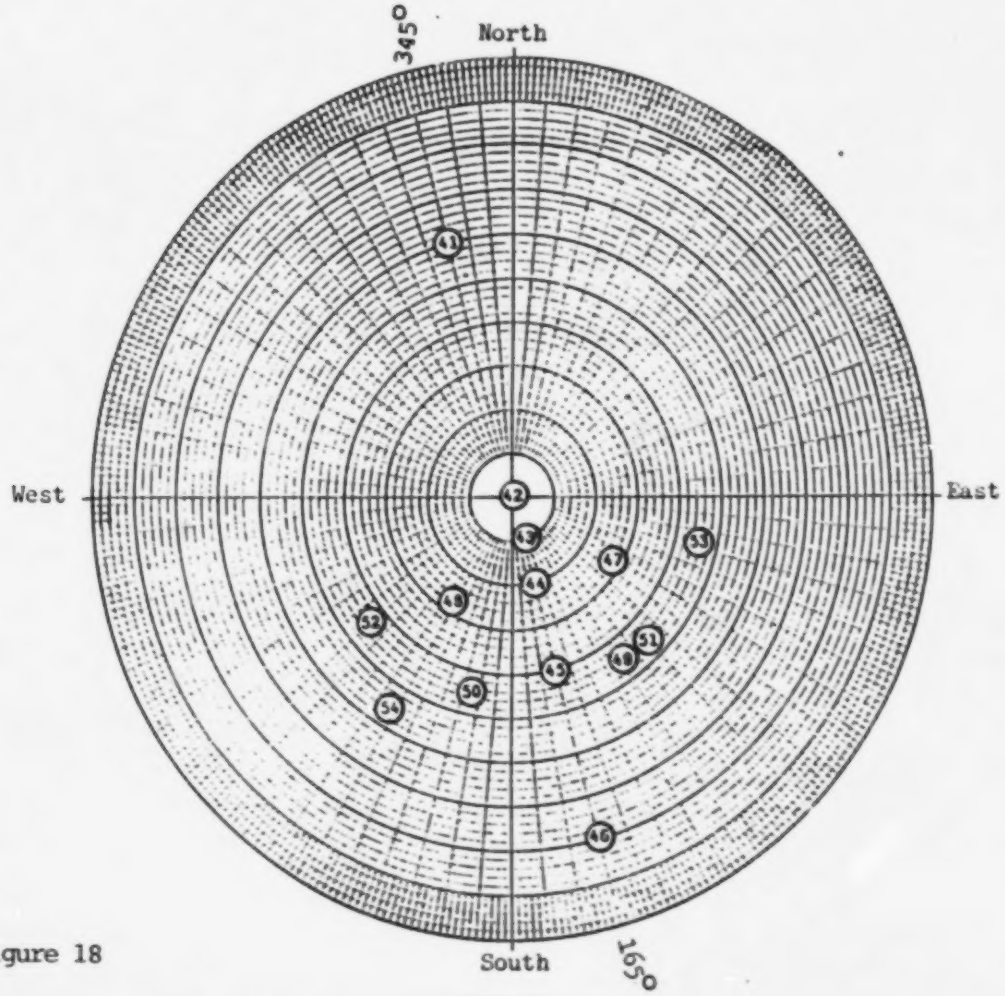


Figure 18

DATE 5-21-86 START TIME 1300 STOP TIME 1330

TUBE #	AIR VOLUME, L	LOCATION DIR.,°	YDS TO SOURCE	LATERAL YDS
T-41	2.88	345	300	0
T-42	2.75	0	SOURCE	0
T-43	3.02	165	50	0
T-52	2.81	165	100	200 W
T-48	2.93	165	100	100 W
T-44	2.95	165	100	0
T-47	3.53	165	100	100 E
T-53	3.25	165	100	200 E
T-54	2.72	165	200	200 W
T-50	3.08	165	200	100 W
T-45	3.07	165	200	0
T-49	3.04	165	200	100 E
T-51	3.03	165	200	DUP 100 E
T-46	2.36	165	400	0

WIND DATA

TIME	TEMP°C	WIND DIR.	STD.DEV.,°	WIND VEL.,m/s
1305	17.3	320		4.87
1310	17.3	288		4.95
1315	17.5	310		4.10
1320	17.5	338		2.10
1325	18.0	332		2.87
1330	17.5	285		1.17
1300-1330	17.5	310	45.1	3.05

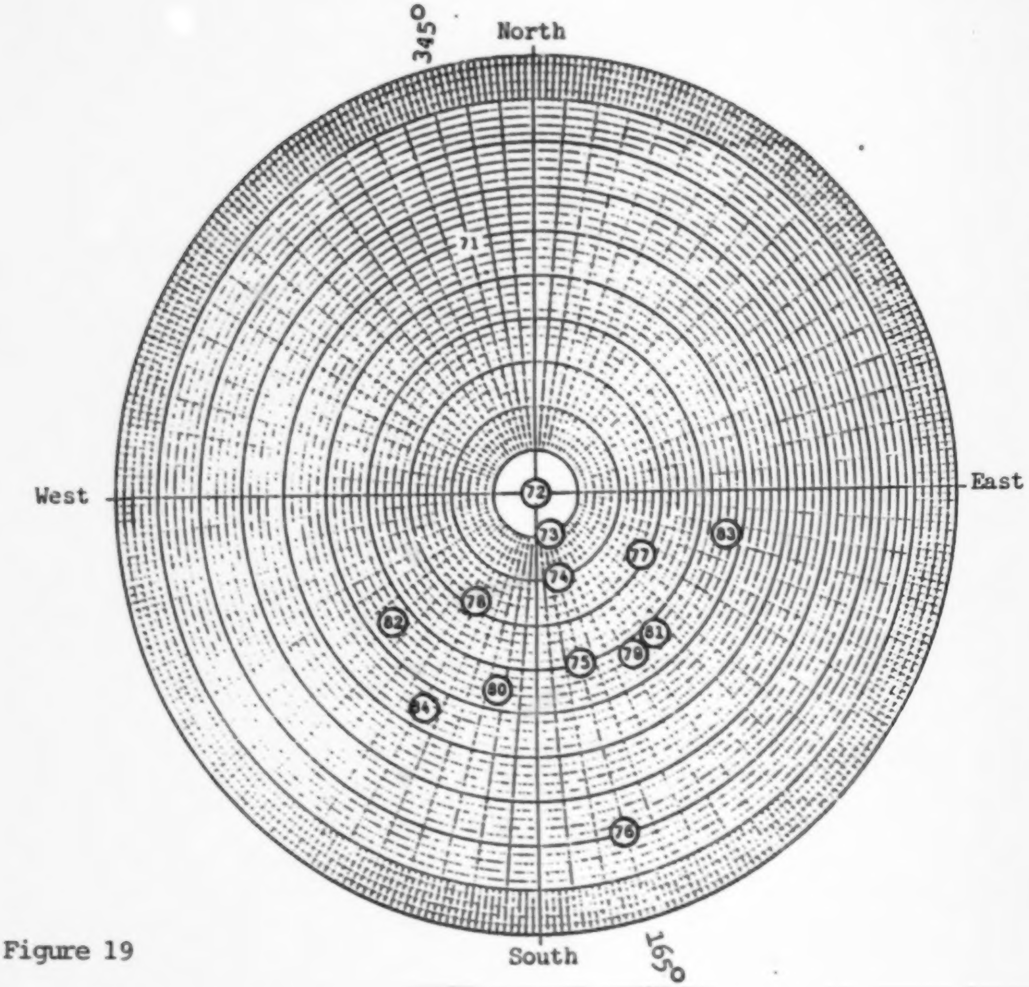

345°
North
71
West
72
East
73
83
77
74
78
82
81
79
75
80
84
76
South
165°

Figure 19

DATE 5-21-88 START TIME 1540 STOP TIME 1610

TUBE #	AIR VOLUME, L	LOCATION DIR.,°	YDS TO SOURCE	LATERAL YDS
T-71	2.92	345	300	0
T-72	2.97	0	SOURCE	0
T-73	2.80	165	50	0
T-82	3.14	165	100	200 W
T-78	2.87	165	100	100 W
T-74	2.98	165	100	0
T-77	2.98	165	100	100 E
T-83	3.23	165	100	200 E
T-84	2.49	165	200	200 W
T-80	2.82	165	200	100 W
T-75	3.09	165	200	0
T-79	2.84	165	200	100 E
T-81	2.83	165	200	DUP 100 E
T-76	3.25	165	400	0

WIND DATA

TIME	TEMP°C	WIND DIR.	STD.DEV.,°	WIND VEL.,m/s
1545	20.1	352		2.00
1550	20.1	316		2.80
1555	20.1	012		2.55
1600	19.6	061		2.00
1605	19.9	025		2.05
1610	20.3	036		1.42
1530-1600	20.0	341	52.5	1.95
1600-1630	20.3	346	48.9	2.45

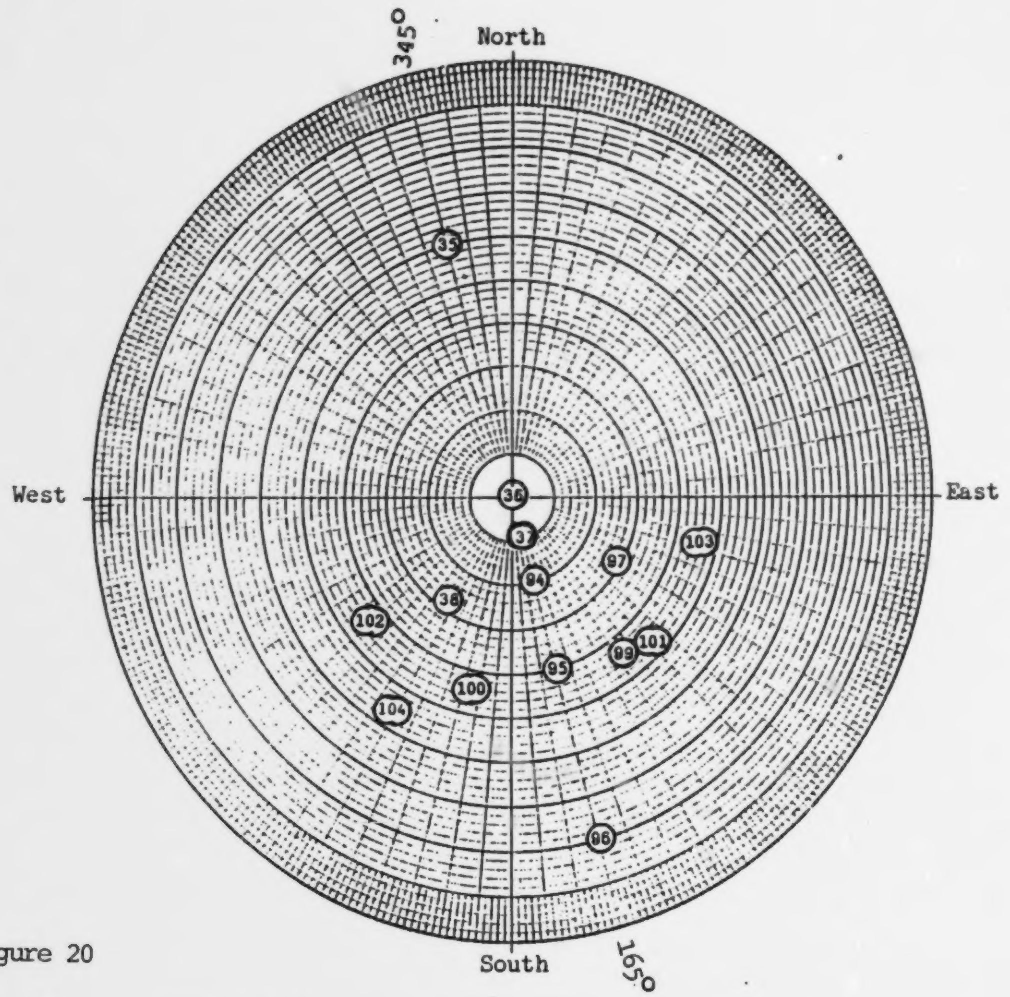


Figure 20

DATE 5-21-86 START TIME 1745 STOP TIME 1815

TUBE #	AIR VOLUME, L		LOCATION	
		DIR., °	YDS TO SOURCE	LATERAL YDS
T-35	2.44	345	300	0
T-36	3.67	0	SOURCE	0
T-37	2.83	165	50	0
T-102	2.95	165	100	200 W
T-38	3.10	165	100	100 W
T-94	3.28	165	100	0
T-97	3.04	165	100	100 E
T-103	3.11	165	100	200 E
T-104	3.63	165	200	200 W
T-100	2.99	165	200	100 W
T-95	3.13	165	200	0
T-99	2.57	165	200	100 E
T-101	3.02	165	200	DUP 100 E
T-96	2.45	165	400	0

WIND DATA

TIME	TEMP°C	WIND DIR.	STD.DEV., °	WIND VEL., m/s
1750	20.3	320		5.55
1755	20.4	317		5.45
1800	20.3	352		5.95
1805	20.2	339		6.12
1810	20.1	340		5.25
1815	20.1	323		5.02
1820	19.9	336		6.37
1730-1800	20.3	330	17.0	5.42
1800-1830	20.0	332	12.8	5.57

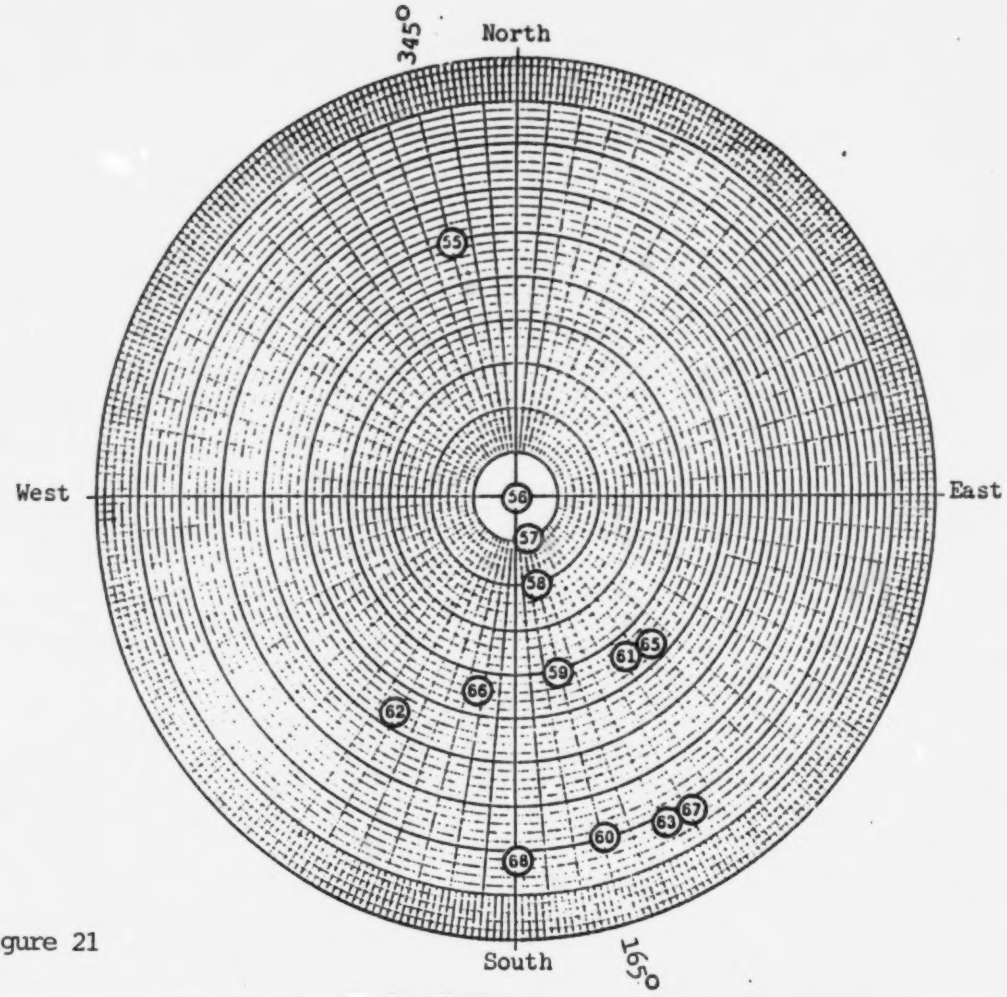


Figure 21

DATE 5-22-86 START TIME 1800 STOP TIME 1830

TUBE #	AIR VOLUME, L		LOCATION	
		DIR.,°	YDS TO SOURCE	LATERAL YDS
T-55	2.89	345	300	0
T-56	3.07	0	SOURCE	0
T-57	3.03	165	50	0
T-58	3.06	165	100	0
T-62	2.88	165	200	200 W
T-59	2.74	165	200	0
T-61	2.55	165	200	100 E
T-65	2.81	165	200	DUP 100 E
T-68	2.90	165	400	100 W
T-60	4.46	165	400	0
T-63	2.72	165	400	100 E
T-67	3.04	165	400	DUP 100 E
T-66	GAS LEAK	165	200	100 W
T-64	DID NOT RUN	165	600	0

WIND DATA

TIME	TEMP°C	WIND DIR.	STD.DEV.,°	WIND VEL.,m/s
1805	21.4	350		2.80
1810	21.4	001		2.65
1815	21.6	000		2.40
1820	21.4	328		2.70
1825	21.5	335		1.40
1800-1830	21.4	346	28.2	2.22

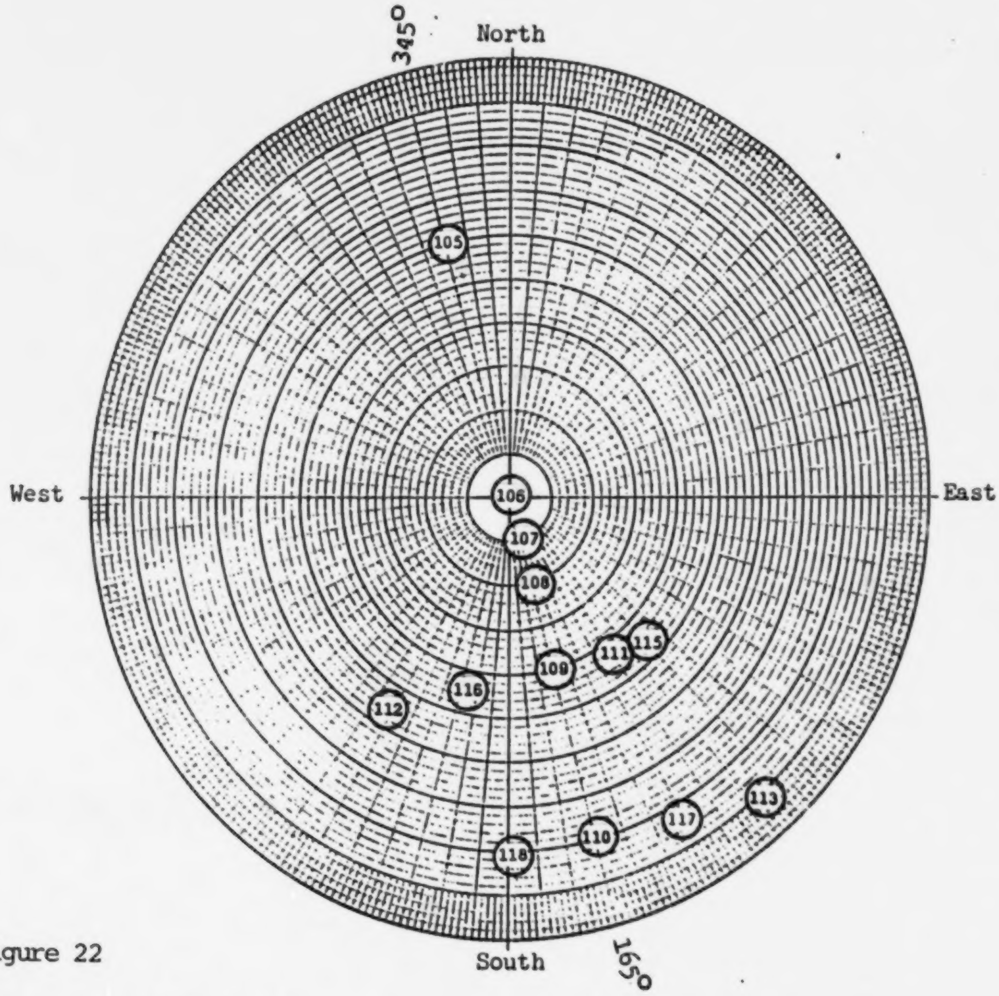


Figure 22

DATE 5-22-86 **START TIME** 2020 **STOP TIME** 2050

TUBE #	AIR VOLUME, L	DIR.,°	LOCATION YDS TO SOURCE	LATERAL YDS
T-105	2.39	345	300	0
T-106	4.11	0	SOURCE	0
T-107	3.19	165	50	0
T-108	2.67	165	100	0
T-112	2.53	165	200	200 W
T-116	2.87	165	200	100 W
T-109	2.79	165	200	0
T-111	3.47	165	200	100 E
T-115	5.25	165	200	DUP 100 E
T-118	2.71	165	400	100 W
T-110	3.02	165	400	0
T-117	2.94	165	400	100 E
T-113	3.18	165	400	200 E
T-114	DID NOT RUN	165	600	0

WIND DATA

TIME	TEMP°C	WIND DIR.	STD.DEV.,°	WIND VEL.,m/s
2025	17.5	141		0.87
2030	17.0	170		0.90
2035	17.0	160		0.77
2040	16.5	187		0.82
2045	16.5	207		1.15
2050	15.3	229		1.57
2055	14.8	232		2.12
2000-2030	17.8	123	27.0	1.05
2030-2100	15.8	217	33.6	1.25

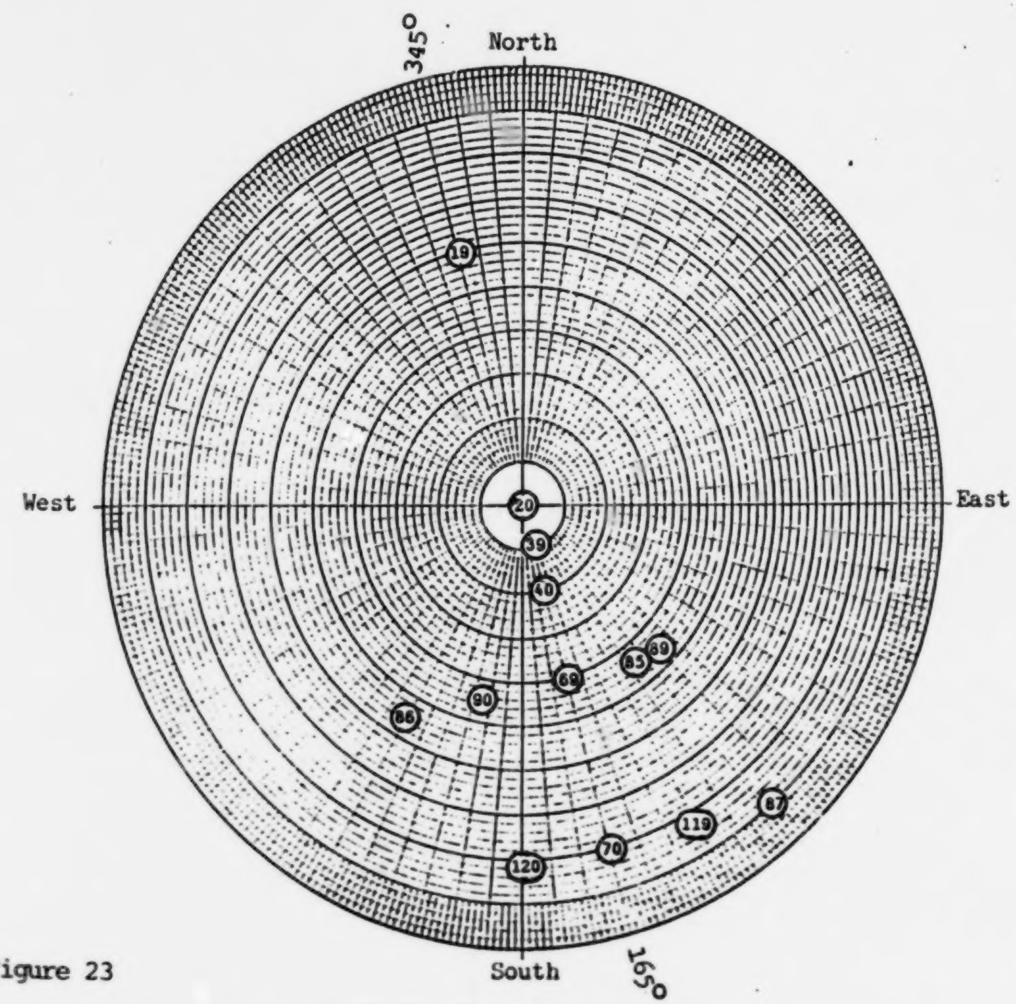


Figure 23

DATE 5-23-86 START TIME 1050 STOP TIME 1120

TUBE #	AIR VOLUME, L	LOCATION DIR.,°	YDS TO SOURCE	LATERAL YDS
T-19	3.35	345	300	0
T-20	3.42	0	SOURCE	0
T-39	2.51	165	50	0
T-40	3.16	165	100	0
T-88	3.17	165	200	200 W
T-90	3.07	165	200	100 W
T-69	3.25	165	200	0
T-85	2.65	165	200	100 E
T-89	3.19	165	200	DUP 100 E
T-120	3.27	165	400	100 W
T-70	2.95	165	400	0
T-119	2.59	165	400	100 E
T-87	3.21	165	400	200 E

WIND DATA

TIME	TEMP°C	WIND DIR.	STD.DEV.,°	WIND VEL.,m/s
1055	21.3	038		2.65
1100	20.7	082		2.60
1105	20.9	010		0.75
1110	20.6	089		2.10
1115	21.1	000		3.17
1120	21.0	321		1.35
1030-1100	20.5	001	49.2	1.67
1100-1130	21.2	014	62.9	1.52

Table 35. Analyses of canisters from the Taft Site, Third episode.

Mass (ng)

Cani-ster #	Trap #	Benzene	Toluene	Ethyl Benzene	m- & p-Xylene	ortho Xylene	REMARKS
1	121	trace*	3.19	2.91	nd	nd	Upwind
1	122	trace*	2.29	2.91	1.36	1.83	Upwind duplicate
2	123	107.24	49.33	28.58	87.88	21.39	Source
3	124	5.31	35.76	16.30	52.00	35.44	Source
4	140	28.12	78.58	5.54	150.16	148.99	200yds@195deg
5	142	3.57	3.93	nd	nd	3.81	200yds@195deg
6	127	5.34	20.18	22.77	30.86	13.53	Upwind
7	129	2.18	6.89	11.70	6.71	4.98	Origin
8	131	6.57	14.94	12.59	19.16	17.09	Origin
8	143	22.11	2.42	nd	8.68	0.15	Origin duplicate
9	132	nd	2.22	3.57	2.90	nd	200-0deg
10	133	4.69	2.95	nd	nd	nd	200-0deg
11	134	3.05	6.09	nd	nd	nd	Upwind
12	135	9.36	15.04	17.56	14.12	6.71	Origin
13	136	13.11	29.93	38.95	22.36	7.16	Origin
14	137	4.88	6.96	2.09	3.30	0.72	200-0deg
15	138	7.11	4.07	nd	1.82	4.75	200-0deg
15	139	1.18	6.34	2.36	3.42	1.26	200-0deg duplicate

*<0.01
nd: Not detected

Concentration (ppbV)

Cani-ster #	Trap #	Benzene	Toluene	Ethyl Benzene	m- & p Xylene	ortho Xylene	REMARKS
1	121	trace*	0.43	0.34	nd	nd	Upwind
1	122	trace*	0.31	0.34	0.16	0.22	Upwind duplicate
2	123	13.22	5.16	2.59	7.97	1.94	Source
3	124	0.85	4.86	1.92	6.13	4.18	Source
4	140	4.51	10.68	0.65	17.71	17.57	200yds@195deg
5	142	0.76	0.71	nd	nd	0.60	200yds@195deg
6	127	0.86	2.74	2.68	3.64	1.60	Upwind
7	129	0.35	0.94	1.38	0.79	0.59	Origin
8	131	1.05	2.03	1.48	2.26	2.02	Origin
8	143	3.54	0.33	nd	1.03	0.02	Origin duplicate
9	132	nd	0.30	0.42	0.34	nd	200-0deg
10	133	0.75	0.40	nd	nd	nd	200-0deg
11	134	0.49	0.83	nd	nd	nd	Upwind
12	135	2.40	3.27	3.31	2.66	1.27	Origin
13	136	2.10	4.07	4.59	2.64	0.84	Origin
14	137	0.78	0.95	0.25	0.39	0.08	200-0deg
15	138	1.14	0.55	nd	0.21	0.56	200-0deg
15	139	0.19	0.86	0.28	0.40	0.15	200-0deg duplicate

*<0.01
nd: Not detected

Table 36. Analyses of Tenax tubes from the Taft site, third eipsode 5-20-86, 1855-1925.

Mass (ng)

Location	Trap #	Benzene	Toluene	Ethyl Benzene	m- & p- Xylene	Ortho Xylene	REMARKS
Upwind	18	1.20	1.29	3.65	4.04	1.89	No field
400-0	8	11.71	2.13	2.06	3.69	2.79	
200-200w	16	3.13	1.17	3.51	3.24	2.13	
200-100w	12	0.56	2.65	1.83	3.82	2.29	
200-0	7	1.49	trace*	10.83	4.86	2.88	
200-100e	15	4.46	2.85	19.45	4.96	2.74	
200-100e	17	2.18	2.31	10.04	3.94	2.56	co-located
100-200w	14	0.96	1.24	2.66	3.48	3.11	
100-100w	10	nd	1.71	17.82	8.96	4.60	
100-0	6	0.79	2.16	13.98	11.62	4.52	
100-100e	9	591.35	2414.40	35.91	107.04	287.94	
100-200e	13	1.04	1.66	0.92	0.86	2.18	
50-0	5	583.53	2210.90	49.00	108.84	448.89	
0-0	4	1.66	2.97	1.98	7.21	1.22	

* <0.01
nd: not detected

Concentration(ppbV)

Location	Trap #	Benzene	Toluene	Ethyl Benzene	m- & p- Xylene	Ortho Xylene	REMARKS
Upwind	18						No field
400-0	8	1.54	0.24	0.20	0.36	0.27	
200-200w	16	0.33	0.11	0.28	0.25	0.17	
200-100w	12	0.06	0.25	0.15	0.31	0.18	
200-0	7	0.15	trace*	0.80	0.36	0.21	
200-100e	15	0.56	0.30	1.80	0.46	0.25	
200-100e	17	0.25	0.23	0.86	0.34	0.22	co-located
100-200w	14	0.10	0.12	0.21	0.28	0.25	
100-100w	10	nd	0.15	1.34	0.67	0.35	
100-0	6	0.08	0.18	1.03	0.86	0.33	
100-100e	9	60.94	210.96	2.72	8.12	21.84	
100-200e	13	0.11	0.15	0.07	0.07	0.17	
50-0	5	60.53	194.43	3.74	8.31	34.26	
0-0	4	0.18	0.27	0.16	0.57	0.10	

* <0.01
nd: not detected

Table 37. Analyses of Tenax tubes from the Taft site, third eipsode 5-21-86, 1145-1216.

Mass (ng)

Location	Trap #	Benzene	Toluene	Ethyl Benzene	m- & p- Xylene	Ortho Xylene	REMARKS
Upwind	21	1.10	nd	nd	2.86	0.54	
400-0	26	18.25	55.88	0.88	12.97	6.90	
200-200w	34	16.25	44.52	7.73	8.94	2.50	
200-100w	30	17.57	50.38	16.47	11.63	4.92	
200-0	25	20.13	61.33	12.70	11.39	4.92	
200-100e	29						Lost pressure on GC
200-100e	31	17.66	28.29	32.96	10.19	5.95	co-located
100-200w	32	9.44	37.28	42.01	4.55	8.38	
100-100w	28	14.92	42.54	6.72	11.40	7.86	
100-0	24	4.27	4.25	16.12	9.16	4.68	
100-100e	27	14.74	43.61	8.83	13.28	8.61	
100-200e	33	18.80	22.94	85.10	24.52	17.24	
50-0	23	1.37	3.24	13.62	10.42	5.05	
0-0	22	2.88	6.05	28.30	14.14	8.02	

nd-not detected

Concentration(ppbV)

Location	Trap #	Benzene	Toluene	Ethyl Benzene	m- & p- Xylene	ortho Xylene	REMARKS
Upwind	21	0.12	nd	nd	0.24	0.04	
400-0	26	1.95	5.06	0.07	1.02	0.54	
200-200w	34	1.81	4.20	0.63	0.73	0.20	
200-100w	30	2.72	6.61	1.88	1.32	0.56	
200-0	25	1.96	5.07	0.91	0.82	0.35	
200-100e	29						Lost pressure on GC
200-100e	31	1.82	2.47	2.50	0.77	0.45	co-located
100-200w	32	1.24	4.17	4.08	0.44	0.81	
100-100w	28	1.60	3.88	0.53	0.90	0.62	
100-0	24	0.50	0.42	1.40	0.79	0.41	
100-100e	27	1.51	3.80	0.67	1.00	0.65	
100-200e	33	2.30	2.38	7.66	2.21	1.55	
50-0	23	0.16	0.32	1.16	0.88	0.43	
0-0	22	0.32	0.57	2.31	1.15	0.65	

nd-not detected

Table 38. Analyses of Tenax tubes from the Taft site, third episode 5-21-86, 1300-1330.

Mass (ng)

Location	Trap #	Benzene	Toluene	Ethyl Benzene	m- & p- Xylene	Ortho Xylene	REMARKS
Upwind	41	3.45	0.73	47.40	3.40	2.61	
400-0	46	2.34	0.73	23.45	9.10	1.47	
200-200w	54	6.96	3.10	72.25	14.96	14.13	
200-100w	50	nd	0.85	57.28	17.91	5.41	
200-0	45	4.12	2.01	10.89	12.18	2.14	
200-100e	49	5.97	9.18	26.84	15.29	5.05	
200-100e	51	496.27	5.89	380.07	44.71	62.09	co-located
100-200w	52	6.26	0.92	1.45	16.08	4.41	
100-100w	48	1.62	1.31	35.16	14.00	6.91	
100-0	44	4.19	2.54	32.64	11.60	3.39	
100-100e	47	6.43	6.69	1.31	23.67	12.99	
100-200e	53	3.79	3.42	15.58	14.42	10.20	
50-0	43	193.10	14.74	1.38	14.21	7.12	
0-0	42	1.14	5.72	40.69	12.64	4.27	

Concentration(ppbV)

Location	Trap #	Benzene	Toluene	Ethyl Benzene	m- & p- Xylene	Ortho Xylene	REMARKS
Upwind	41	0.41	0.07	4.17	0.30	0.23	
400-0	46	0.32	0.08	2.34	0.91	0.15	
200-200w	54	0.82	0.31	6.26	1.30	1.22	
200-100w	50	nd	0.07	4.39	1.37	0.41	
200-0	45	0.43	0.18	0.84	0.94	0.16	
200-100e	49	0.63	0.82	2.08	1.19	0.39	
200-100e	51	52.50	0.53	29.58	3.48	4.83	co-located
100-200w	52	0.71	0.09	0.12	1.35	0.37	
100-100w	48	0.18	0.12	2.83	1.13	0.56	
100-0	44	0.46	0.23	2.61	0.93	0.27	
100-100e	47	0.58	0.51	0.09	1.58	0.87	
100-200e	53	0.37	0.29	1.13	1.05	0.74	
50-0	43	20.49	1.33	0.11	1.11	0.56	
0-0	42	0.13	0.56	3.49	1.08	0.37	

Table 39. Analyses of Tenax tubes from the Taft site, third episode 5-21-86, 1540-1610.

Mass (ng)

Location	Trap #	Benzene	Toluene	Ethyl Benzene	m- & p- Xylene	Ortho Xylene	REMARKS
Upwind	71	2.30	nd	11.54	5.36	1.41	
400-0	76	2.45	nd	nd	11.18	1.97	
200-200w	84	1.39	0.59	32.13	4.69	6.27	
200-100w	80	nd	trace*	nd	14.99	trace*	
200-0	75	20.86	trace*	trace*	12.00	1.19	questionable benzene
200-100e	79	318.79	638.16	3.25	24.47	66.52	co-located
200-100e	81						Lost pressure
100-200w	82	2.35	0.57	19.93	8.26	3.34	
100-100w	78	6.02	2.36	0.76	10.69	3.75	
100-0	74	5.37	3.33	1.26	10.20	1.98	
100-100e	77	717.84	86.25	7.67	63.38	54.39	
100-200e	83	5.62	6.96	2.31	20.80	9.78	
50-0	73	1.33	1.63	1.32	13.07	5.60	
0-0	72	6.40	3.57	48.08	12.55	57.80	

* <0.01

Concentration(ppbV)

Location	Trap #	Benzene	Toluene	Ethyl Benzene	m- & p- Xylene	Ortho Xylene	REMARKS
Upwind	71	0.25	nd	0.93	0.43	0.11	
400-0	76	0.24	nd	nd	0.81	0.14	
200-200w	84	0.18	0.06	3.04	0.44	0.59	
200-100w	80	nd	trace*	nd	1.25	trace*	
200-0	75	2.17	trace*	trace*	0.92	0.09	questionable benzene
200-100e	79	35.98	61.06	0.27	2.03	5.52	co-located
200-100e	81						Lost pressure
100-200w	82	0.24	0.05	1.50	0.62	0.25	
100-100w	78	0.67	0.22	0.06	0.88	0.31	
100-0	74	0.58	0.30	0.10	0.81	0.16	
100-100e	77	77.73	7.92	0.61	5.05	4.33	
100-200e	83	0.58	0.59	0.17	1.52	0.71	
50-0	73	0.15	0.16	0.11	1.10	0.47	
0-0	72	0.69	0.33	3.82	1.00	4.59	

* <0.01

Table 40. Analyses of Tenax tubes from the Taft site, third episode 5-21-86, 1745-1815.

Mass (ng)

Location	Trap #	Benzene	Toluene	Ethyl Benzene	m- & p- Xylene	Ortho Xylene	REMARKS
Upwind	35	2.20	0.53	21.20	4.05	2.29	
400-0	96	7.22	2.68	15.33	6.85	1.57	
200-200w	104	2.94	1.46	2.26	10.74	4.46	
200-100w	100	4.13	1.97	6.27	9.40	1.85	
200-0	95	6.97	2.21	1.19	11.19	2.75	
200-100e	99	8.23	3.83	1.62	17.45	4.95	
200-100e	101	2.14	4.57	1.45	12.74	6.27	co-located
100-200w	102	0.92	1.54	2.00	10.29	2.61	
100-100w	38	1.68	9.32	2.02	30.39	2.15	
100-0	94	201.57	13.79	2.15	18.50	11.98	
100-100e	97	103.67	18.41	2.36	19.84	14.98	
100-200e	103	246.54	24.74	5.91	23.83	16.76	
50-0	37	nd	nd	18.47	6.70	5.85	
0-0	36	1.56	6.72	3.48	13.89	5.02	
	2	18.15	36.60	5.66	32.44	7.74	no field data given

Concentration(ppbV)

Location	Trap #	Benzene	Toluene	Ethyl Benzene	m- & p- Xylene	Ortho Xylene	REMARKS
Upwind	35	0.29	0.06	2.05	0.39	0.22	
400-0	96	0.94	0.30	1.48	0.66	0.15	
200-200w	104	0.26	0.11	0.15	0.70	0.29	
200-100w	100	0.44	0.18	0.49	0.74	0.15	
200-0	95	0.71	0.19	0.09	0.84	0.21	
200-100e	99	1.03	0.40	0.15	1.60	0.45	
200-100e	101	0.23	0.41	0.11	1.00	0.49	co-located
100-200w	102	0.10	0.14	0.16	0.82	0.21	
100-100w	38	0.17	0.82	0.15	2.31	0.16	
100-0	94	19.70	1.14	0.15	1.33	0.86	
100-100e	97	10.93	1.65	0.18	1.54	1.16	
100-200e	103	25.41	2.16	0.45	1.81	1.27	
50-0	37	nd	nd	1.54	0.56	0.49	
0-0	36	0.14	0.50	0.22	0.89	0.32	
	2						no field data given

Table 41. Analyses of Tenax tubes from the Taft site, third episode 5-22-86, 1800-1830.

Mass (ng)

Location	Trap #	Benzene	Toluene	Ethyl Benzene	m- & p- Xylene	Ortho Xylene	REMARKS
Upwind	55	190.28	2288.70	44.04	113.93	191.21	End of tube not sealed
400-100E	63	trace*	2.33	25.31	3.12	trace*	
400-100W	68	3.48	2.98	44.82	4.61	2.62	
400-0	60	5.12	4.54	1.13	5.48	0.34	
400-100E	67	6.62	4.55	28.31	5.46	2.29	
200-200W	62	1.14	2.82	nd	3.03	1.30	
	66						Problem in field
200-0	59	24.72	4.85	37.74	1.99	2.22	
200-100E	61	10.75	3.08	55.17	6.49	4.20	
200-100E	65	12.90	4.23	39.89	6.53	4.32	co-located
100-0	58	5.33	3.91	1.22	6.33	2.78	
50-0	57	3.18	3.47	34.04	6.84	4.20	
0-0	56	28.34	8.43	2.02	7.96	2.16	
600-0	64						Problem in field

Concentration(ppbV)

Location	Trap #	Benzene	Toluene	Ethyl Benzene	m- & p- Xylene	Ortho Xylene	REMARKS
Upwind	55	22.67	231.20	3.86	9.99	16.76	End of tube not sealed
400-100E	63	trace*	0.23	2.19	0.27	trace*	
400-100W	68	0.38	0.28	3.64	0.37	0.21	
400-0	60	0.37	0.28	0.06	0.29	0.02	
400-100E	67	0.70	0.41	2.20	0.42	0.18	
200-200W	62	0.14	0.29	nd	0.27	0.12	
	66						Problem in field
200-0	59	2.89	0.48	3.25	0.17	0.19	
200-100E	61	1.35	0.33	5.10	0.60	0.39	
200-100E	65	1.58	0.44	3.60	0.59	0.39	co-located
100-0	58	0.56	0.35	0.09	0.49	0.21	
50-0	57	0.34	0.31	2.65	0.53	0.33	
0-0	56	2.96	0.75	0.16	0.61	0.17	
600-0	64						Problem in field

Table 42. Analyses of Tenax tubes from the Taft site, third episode 5-22-86, 2020-2050.

Mass (ng)

Location	Trap #	Benzene	Toluene	Ethyl Benzene	m- & p- Xylene	Ortho Xylene	REMARKS
Upwind	105	18.92	23.63	10.22	26.16	16.75	
400-100W	118	9.69	4.12	5.48	8.20	3.37	
400-0	110	22.75	13.10	19.85	9.22	5.76	
400-100E	117	20.95	19.58	15.67	8.42	10.41	
400-200E	113	25.77	11.08	6.74	6.22	4.84	
200-200W	112	33.21	24.38	12.20	15.81	8.08	
200-100W	116	3.73	14.10	17.05	4.57	9.92	
200-0	109	70.09	202.81	5.05	9.58	12.95	Pressure lost
200-100E	111	15.05	5.98	8.62	6.84	5.16	
200-100E	115	18.94	23.20	20.82	10.86	8.94	
100-0	108	296.03	3044.70	37.99	127.87	78.38	co-located
50-0	107	15.10	13.42	7.45	8.01	6.08	
0-0	106	24.32	23.91	11.71	14.22	10.07	
600-0	114						Problem in field no sample

Concentration(ppbV)

Location	Trap #	Benzene	Toluene	Ethyl Benzene	m- & p- Xylene	Ortho Xylene	REMARKS
Upwind	105	2.54	2.69	1.01	2.58	1.65	
400-100W	118	1.15	0.41	0.48	0.71	0.29	
400-0	110	2.41	1.18	1.55	0.72	0.45	
400-100E	117	2.28	1.81	1.26	0.68	0.84	
400-200E	113	2.60	0.95	0.50	0.46	0.36	
200-200W	112	4.21	2.62	1.14	1.47	0.75	
200-100W	116	0.42	1.33	1.40	0.38	0.82	
200-0	109	8.05	19.75	0.43	0.81	1.09	Pressure lost
200-100E	111	1.39	0.47	0.59	0.46	0.35	
200-100E	115	1.16	1.20	0.94	0.49	0.40	
100-0	108	35.54	309.87	3.36	11.30	6.92	co-located
50-0	107	1.52	1.14	0.55	0.59	0.45	
0-0	106	1.90	1.58	0.67	0.82	0.58	
600-0	114						Problem in field no sample

Table 43. Analyses of Tenax tubes from the Taft site, third episode 5-23-86, 1050-1120.

Mass (ng)

Location	Trap #	Benzene	Toluene	Ethyl Benzene	m- & p- Xylene	Ortho Xylene	REMARKS
Upwind	19	5.92	6.45	12.62	6.40	2.45	
400-100W	120	10.02	6.52	8.70	8.66	2.21	
400-0	70	40.03	10.55	1.65	11.27	5.07	
400-100E	119	6.05	9.34	6.06	9.76	4.21	
400-200E	87	383.29	1977.60	13.59	83.40	114.84	
200-200W	86	16.41	4.33	1.25	9.01	3.08	
200-100W	90	4.40	4.73	1.01	7.64	4.18	
200-0	69	5.14	6.25	4.04	6.26	2.32	
200-100E	85	10.80	4.44	trace*	7.48	5.80	
200-100E	89	12.79	7.23	5.45	8.56	2.38	co-located
100-0	40	5.07	10.23	7.80	7.41	1.58	
50-0	39	8.89	10.34	6.72	9.01	3.61	
0-0	20	4.73	6.56	nd	5.42	2.63	

Concentration(ppbV)

Location	Trap #	Benzene	Toluene	Ethyl Benzene	m- & p- Xylene	Ortho Xylene	REMARKS
Upwind	19	0.57	0.52	0.89	0.45	0.17	
400-100W	120	0.98	0.54	0.63	0.62	0.16	
400-0	70	4.35	0.97	0.13	0.90	0.40	
400-100E	119	0.75	0.98	0.55	0.89	0.38	
400-200E	87	38.27	167.41	1.00	6.13	8.44	
200-200W	86	1.66	0.37	0.09	0.67	0.23	
200-100W	90	0.46	0.42	0.08	0.59	0.32	
200-0	69	0.51	0.52	0.29	0.45	0.17	
200-100E	85	1.31	0.46	trace*	0.66	0.52	
200-100E	89	1.28	0.62	0.40	0.63	0.18	co-located
100-0	40	0.51	0.88	0.58	0.55	0.12	
50-0	39	1.14	1.12	0.63	0.85	0.34	
0-0	20	0.44	0.52	nd	0.37	0.18	

SECTION 6

DISCUSSION OF RESULTS

GENERAL COMMENTS

Phase II of this project included field sampling and data analysis. During the 1985 sampling periods, wind conditions were seldom steady enough to allow a clear determination of average direction and downwind centerline. In fact, daytime solar heating during those episodes in July and September usually caused very unstable atmospheric conditions close to the ground, even into early evening hours, producing a highly variable wind direction. Thus, for all sampling runs, an identifiable wind direction could not be determined, and use of site wind data for receptor or Gaussian model purposes was extremely difficult.

Evaluation of completed 1985 field tests indicates consistent relationships between concentrations of species sampled (toluene, benzene, and ethyl benzene), but relatively poor relationships of the concentrations to atmospheric dispersion parameters. In one case (September 5, 1985), the downwind distribution indicated sharp, discontinuous decreases in concentrations 50 yards downwind from the source; values at 100 and 200 yards downwind were uniformly higher than those at 50 yards. This result indicates either a looping downwind plume, or a sampling problem. Additional data are insufficient to identify the cause of this anomaly. Such a phenonenon would be difficult to simulate with a standard Gaussian model modified by a photochemical reactivity factor. In another case (July 10, 1985), the crosswind of the source shows a very pronounced bi-modal peak, with minimum concentrations at the centerline sampler. This result is likely caused by variation in wind direction, but supporting data are insufficient for a precise identification.

EPA comparative analyses point out discrepancies in both episodes. Tables A-7 through A-10 (Appendix A) compare canister analyses performed at ASRL, RTP, NC. The GGC analytical procedure involved sampling from canisters into Tenax tubes and use of packed column GC with photoionization detection. The ASRL procedure involved cryogenic trapping and vaporization and used capillary GC with FID. In Table A-7, the comparisons are within approximately ± 65-75%, except for ethylbenzene. The differences are attributable not only to the differences in preconcentration procedures but also to the dissimilar columns. Co-eluting and overlapping peaks (primarily in the packed column chromatograms) could contribute to the discrepancies. The comparisons with the EPA mix II (Table A-3) support this conclusion, because the agreement is quite close for benzene and toluene, and only slightly poorer for the xylenes at lower concentrations. Co-eluting or overlapping compounds are absent in this mix.

In the second episode the concentrations from the two laboratories were, in some cases,in excellent agreement, but in others were very poor, probably for the reasons already discussed (Table A-8). Again the agreement for a reference blend, EPA mix I, is excellent (Table A-4).

From the detailed GC-FID measurements made at ASRL in 1985, the C_6-C_8 aromatic compounds totaled from 1.6 to 6.0% of the organic carbon measured in episode 1 and 1.6 to 8.3% (except for one sample with 24.6%) in episode 2. These capillary GCs indicated well over a hundred organic compounds in all canister samples, most of which have not been identified. The retention time of the most abundant component in nearly all cases is consistent with a C_9 olefin (although this is an unlikely component at the level observed). The total organic carbon was higher and more consistent in episode 1, compared to episode 2. The range for episode 1 was 4.1 to 12.9 ppmC, and for episode 2, 2.0 to 3.3 ppmC. This can be attributable to higher ambient temperature and on site dumping activities. During episode 1 sampling, ambient temperature ranged from 102 to 107°F. Although temperature measurements were not recorded during episode 2 sampling, ambient temperature was estimated to be approximately 15 to 20°F lower. Truck deliveries of hazardous waste materials may have been more abundant during the episode 1 sampling period. The winds were quite variable in both episodes 1 and 2, so "upwind/downwind" terms may not be applicable to those data.

The general results of the two sampling episodes in 1985 do not permit any substantive analysis or conclusions regarding receptor or Gaussian modeling, except in a very general way. However, the results pointed out some field sampling deficiencies which were consequently corrected or improved. One such improvement was a rearranged and denser downwind sampling network. Another was the use of a wind direction integrator. These changes were implemented in the third episode sampling during May, 1986.

During the week of May 21-25, 1986, another major sampling effort was conducted. A total of eight gridded sampling trials were completed. The sampling array was initially distributed across the 100 and 200 yard centerline points, and, for later tests, across the 200 and 400 yard centerline points. (The centerline was along the direction of the prevailing wind and usually, but not always, fairly close to the actual wind direction during the sampling). A newly fenced area owned by a drilling company precluded placement of a sampler at the 200-200E point, so a parallel sample was collected at the 200-100E grid point during each such field run.

During this latter sampling period, it was noted that wind conditions during morning hours were generally light and highly variable, and unsuitable for sampling. These atmospheric conditions frequently delayed onset of sampling activities until near mid-day. At that time stronger and more well-defined winds often persisted until near sunset, enabling periods of late afternoon and evening sampling to continue.

Because of a limited number of sample pumps and power sources, it was not possible to run the canister sampling exactly coincident with Tenax tube runs, nor to run all the canisters simultaneously. It had been thought that within the rapid filling time of about ten minutes the consecutive paired canisters would have matching compositions. Co-located canister pairs did match reasonably for total hydrocarbons, but the individual C_6-C_8 aromatics were not as close. Agreement on the aromatics between ASRL and GGC was fair. The poorest comparisons were seen for the three canisters collected onsite. This may suggest that the disagreement was at least partially due to the high concentrations and complex mixture of hydrocarbons onsite. GGC and ASRL used different columns and detector systems. Consequently overlapping peaks and different response factors could account for much of the disagreement observed between the two analysis laboratories. These comparisons are given in Appendix A.

In all runs the striking finding with the canisters when the ASRL capillary analyses were examined was the great complexity of the samples. In some of the canister samples there more than two hundred individual components observed, with total non-methane hydrocarbon values up to 9.5 ppmC. The target aromatic compounds found in the 1986 runs were only a few percent of the total hydrocarbons measured (2.8 to 8.6%, median 5.1%), based on the ASRL canister analyses. The observed composition did not comprise a few compounds at high concentrations, but a large number of compounds at moderate concentrations. This indicates the wide range of chemical species that may have been disposed of in such a facility, and makes modeling efforts difficult.

Comparisons of the individual compounds in highest concentrations in "downwind" canisters for all sites in two canister runs are given in Tables 44 and 45. The observed results are confusing. In Table 44 the increase in total NMOC for downwind canister 4 is significant relative to the upwind canister 1; however many individual compound concentrations in canister 4 are higher than those observed in the onsite samples 2 and 3. Since there was a delay of approximately 15 minutes between the collection of the onsite and the downwind samples such increases can only be explained by bursts of organic compounds that are periodically released. Another explanation is offsite emissions from intermittent sources in the vicinity. The area has petroleum field activity.

Table 44. Eight Most Abundant Organics Observed (ppbC) from the Downwind CAN 4 Canister Samples Collected During the Test 1 Program of Episode 3.

RT_{min}	Compound	Upwind CAN 1	Onsite CAN 2	CAN 3	Downwind CAN 4	CAN 5
12.97	*C_6 Paraffin	35.5	294.7	1.8	53.9	13.2
15.78	Cyclohexane	1.2	15.0	9.8	433.0	N.A.
18.83	Toluene	2.9	180.6	28.1	58.9	4.8
20.78	*C9 Olefin	23.4	153.3	7.8	35.4	N.A.
21.80	m-+p-Xylene	2.3	48.7	49.7	126.9	3.8
22.43	o-Xylene	5.7	15.4	16.7	115.6	6.8
25.28	*C10 Paraffin	11.4	19.2	9.6	22.3	2.4
25.81	*C11 Paraffin	2.2	22.3	34.3	94.0	N.A.

* Tentative identifications

Table 45. Nine Most Abundant Organics Observed (ppbC) from the Downwind CAN 15 Canister Samples Collected During the Test 2 Program of Episode 3.

RT_{min}	Compound	Upwind	Onsite		Downwind
		CAN 11	CAN 12	CAN 13	CAN 15
6.36	n-Butane	12.0	30.4	22.5	25.2
9.28	Isopentane	2.7	18.5	15.0	13.6
10.30	n-Pentane	1.5	12.4	13.6	15.3
12.79	2 Methylpentane	2.5	7.7	7.1	5.6
13.27	3 Methylpentane	4.6	10.0	8.0	5.8
14.71	Methylcyclopentane	3.3	10.9	10.0	9.2
16.78	* C_7 Paraffin	1.4	7.0	6.9	6.4
25.29	* C_{10} Paraffin	n.d.	19.3	5.1	9.4
25.82	* C_{11} Paraffin	0.3	10.0	10.1	7.8

* Tentative identifications

It was hoped that the increased numbers of Tenax cartridge samplers per run in the 1986 study would better define the shape of the plume from the source area. In fact, some runs showed "downwind" peaks that were out of line with other samples. Sampler flows were checked before and after running and none were off by a significant amount. For runs where the wind records indicated steady wind direction, we can only surmise that these anomalies reflect some irregular emission pattern from the source ponds, although there was no dumping activity in progress during this study. The presence of offsite sources is also a possibility.

To illustrate graphically the type of atmospheric concentration data observed in this series of samplings, the observed values for the five measured aromatic hydrocarbons have been plotted individually with concentration contours drawn in visually in Figures 24 through 31. These include the integrated wind direction on the wind rose, along with the standard deviation in wind direction and the temperature, during the sample collection period. They show that the contours for the five hydrocarbons are usually similar in shape, with some exceptions. In some instances, however, the contour maxima do not appear to have resulted from emissions from the source pond areas, given the known wind direction, unless rather sharp bursts of emissions have occurred. Possibly a cloud of vapors of limited volume could have passed through the sampler array during the course of the run, leading to an anomalous maximum within the array. Another possibility is that another source (or sources) external to the ponds emitted sporadically during those runs.

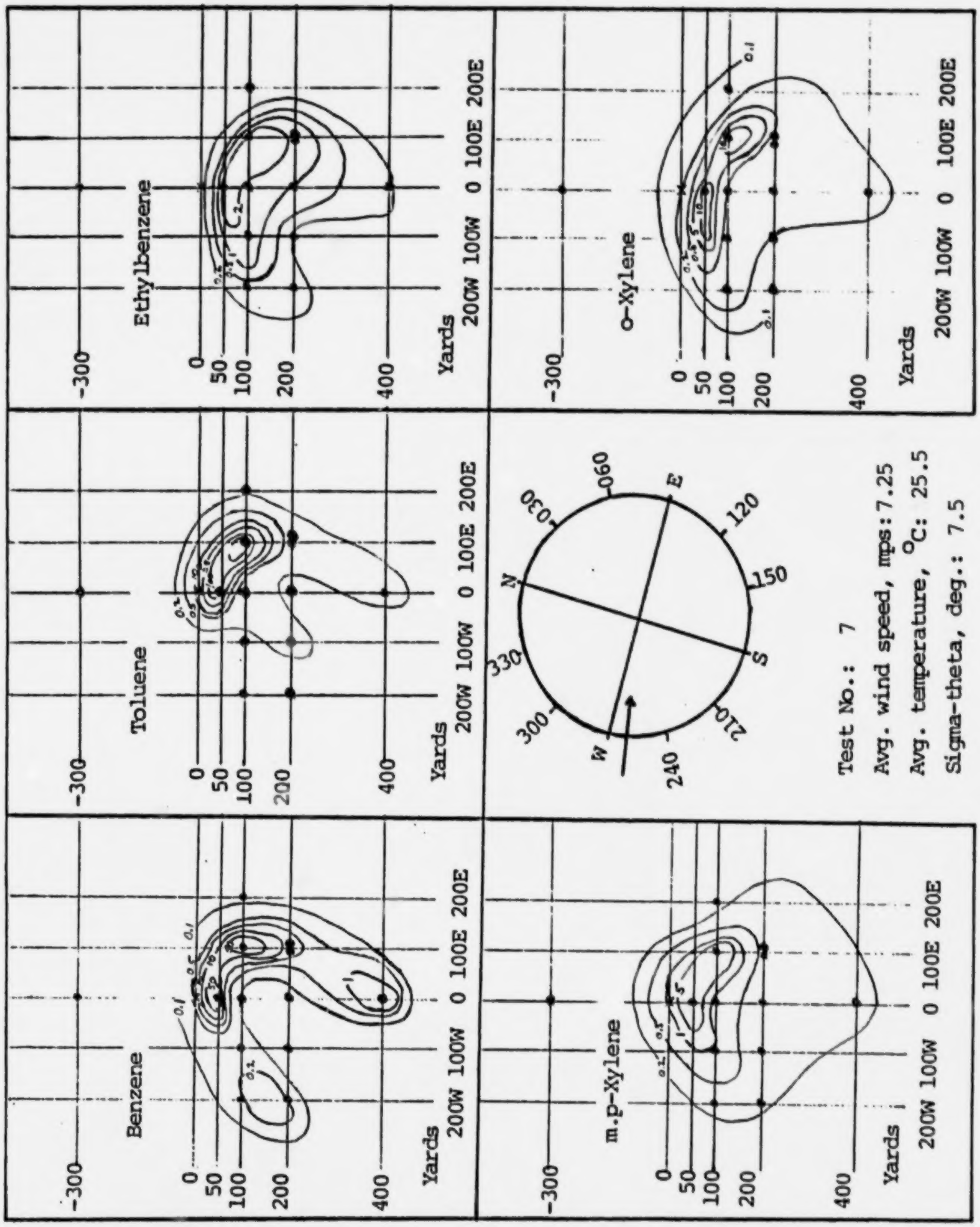
SPECIFIC SAMPLING RESULTS

This section discusses the interpretation of the field sampling trials conducted during this program. Sub-contractor Engineering Science (ES) of Berkeley, California, was given the C_6 to C_8 aromatic hydrocarbon results obtained from the Tenax cartridge analyses to review for Gaussian and receptor model applicability. This section contains the opinions observed from a review of all three study episodes.

(A) INITIAL IMPRESSIONS

Trial 1 - July 10, 1985, 1830-1900

Sample concentrations are consistent in magnitude at comparable downwind distances. The benzene distribution curve peaks at the origin (waste pond), while the toluene and ethyl benzene distribution curves peak 50 yards downwind. These samples results are useful in describing downwind Gaussian dispersion, but data points are insufficient to describe receptor model information. See Figure 32.



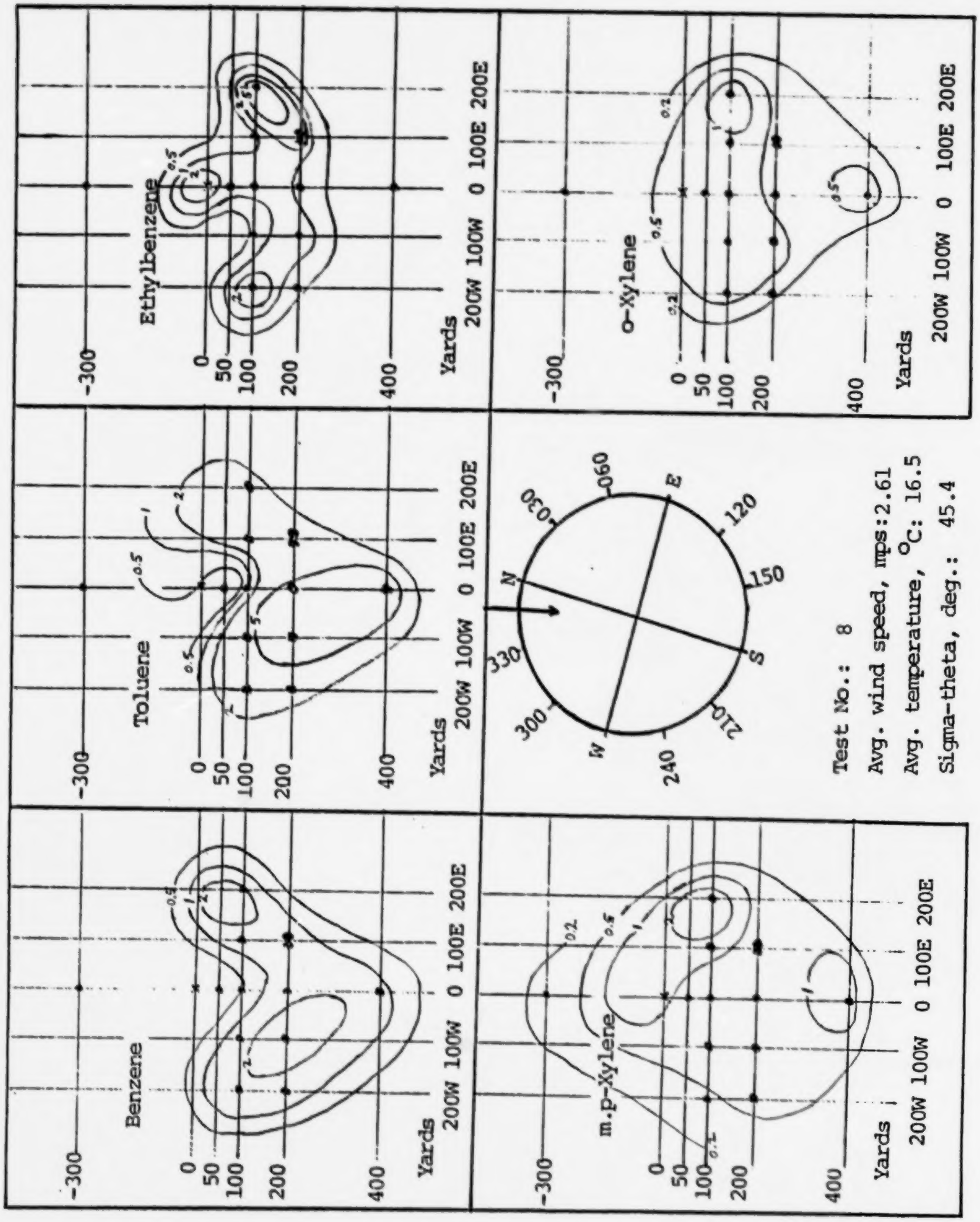
Test No.: 7

Avg. wind speed, mps: 7.25

Avg. temperature, °C: 25.5

Sigma-theta, deg.: 7.5

Figure 24. Contour plots for C_{6-8} aromatics, 5-20-86/1855-1925.



Figuure 25. Contour plots for C_{6-8} aromatics, 5-20-86/1145-1216

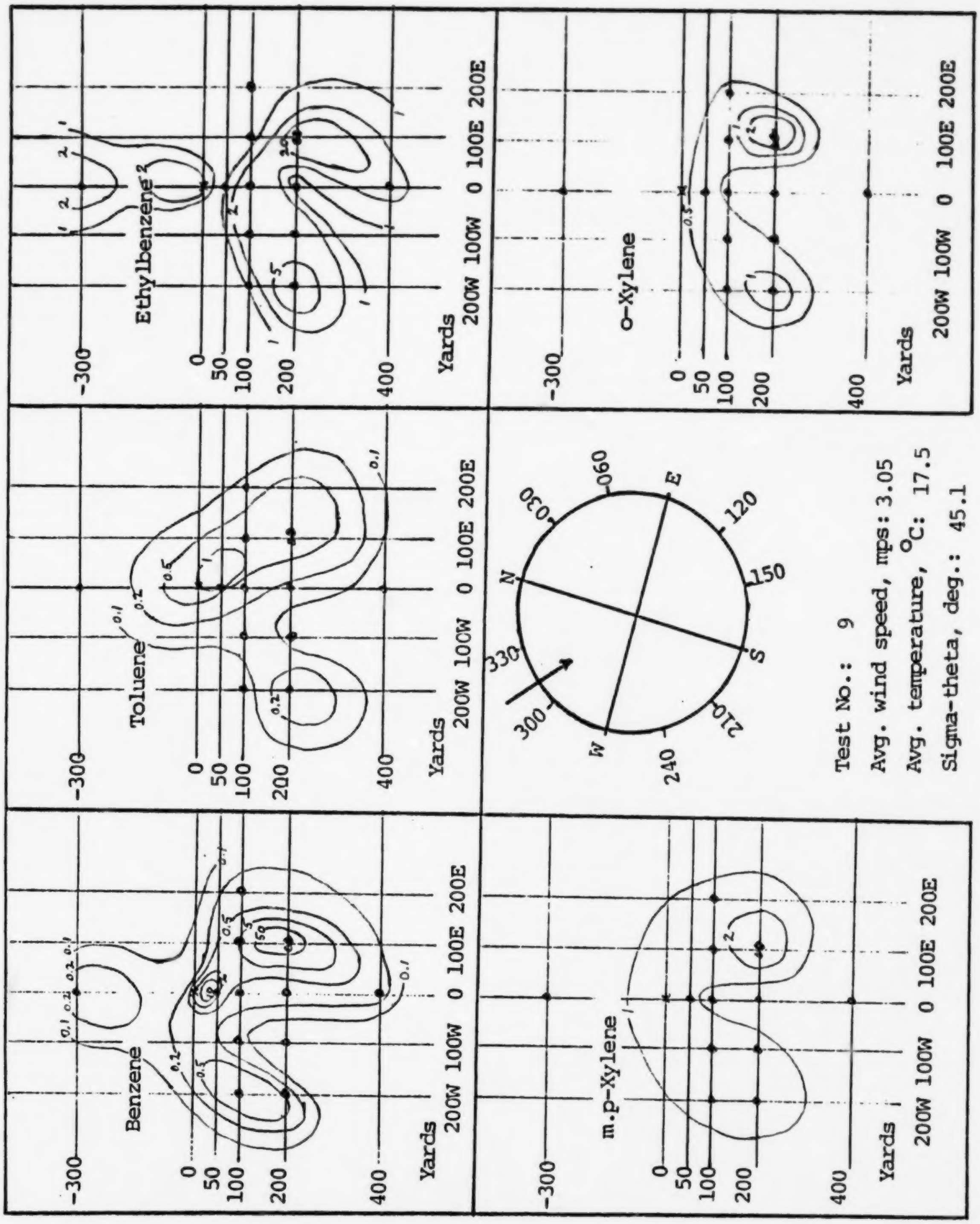
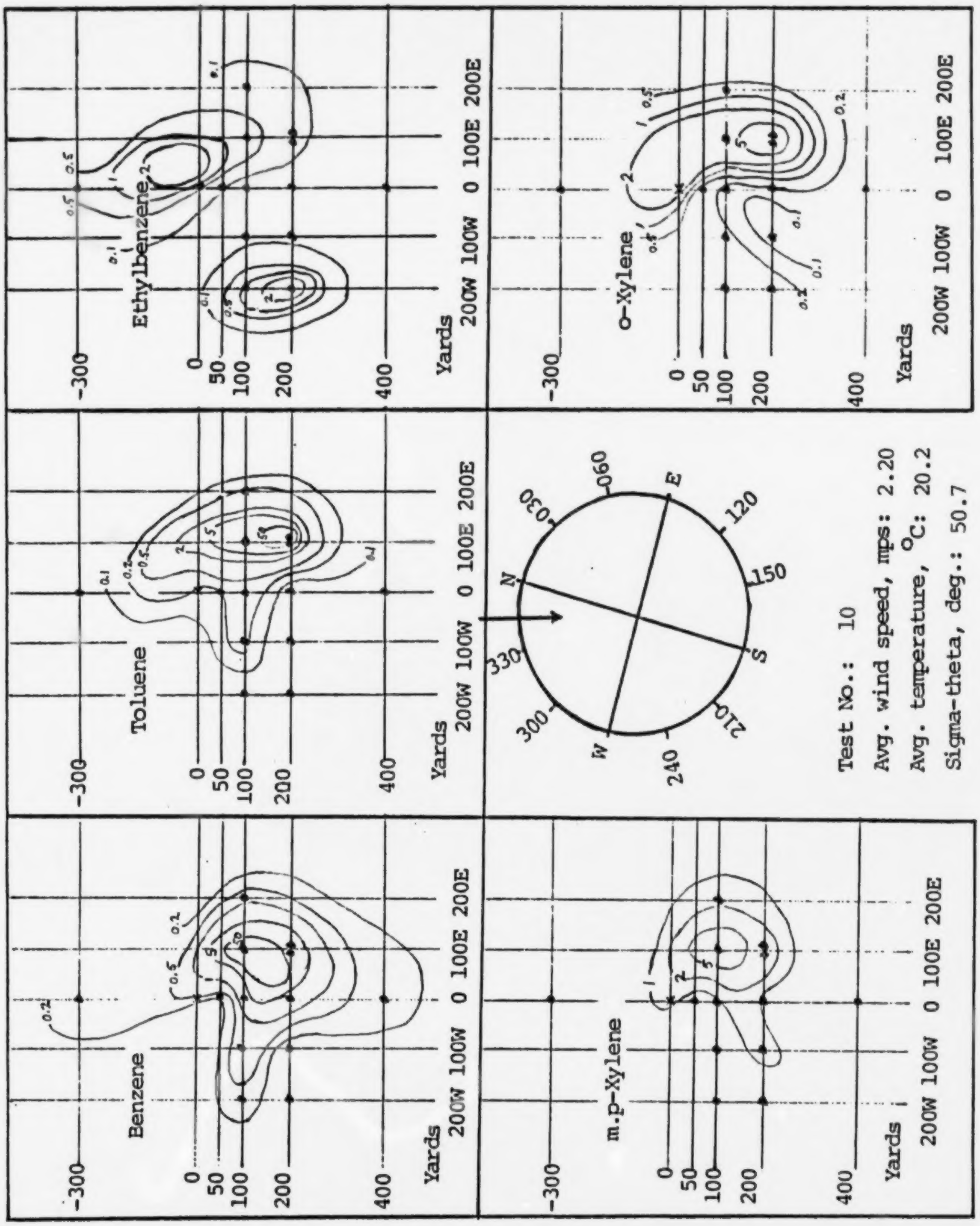


Figure 26. Contour plots for C_{6-8} aromatics, 5-21-86/1300-1330



Test No.: 10

Avg. wind speed, mps: 2.20

Avg. temperature, °C: 20.2

Sigma-theta, deg.: 50.7

Figure 27. Contour plots for C_{6-8} aromatics, 5-21-86/1540-1610.

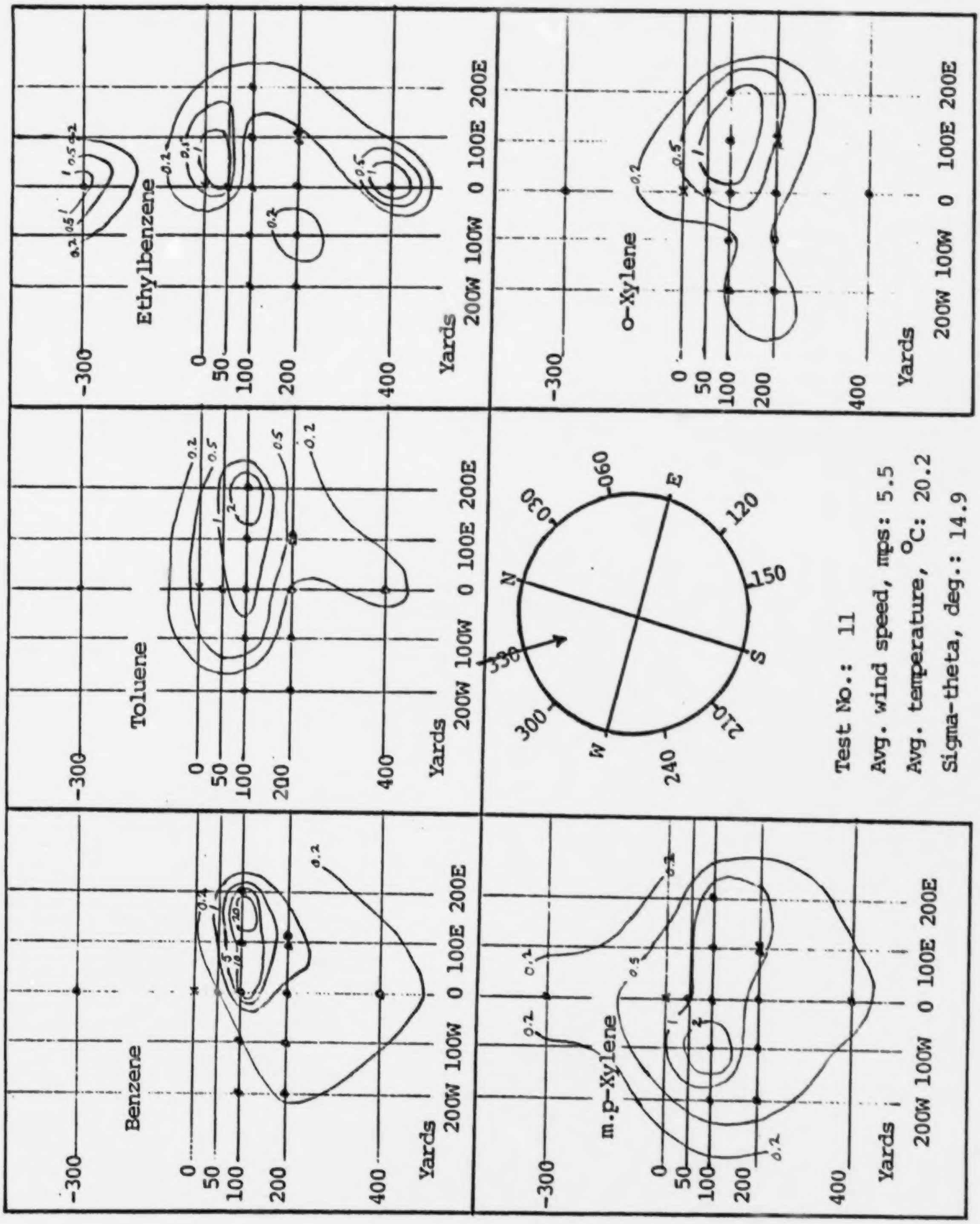


Figure 28. Contour plots for C_{6-8} aromatics, 5-21-86/1745-1815.

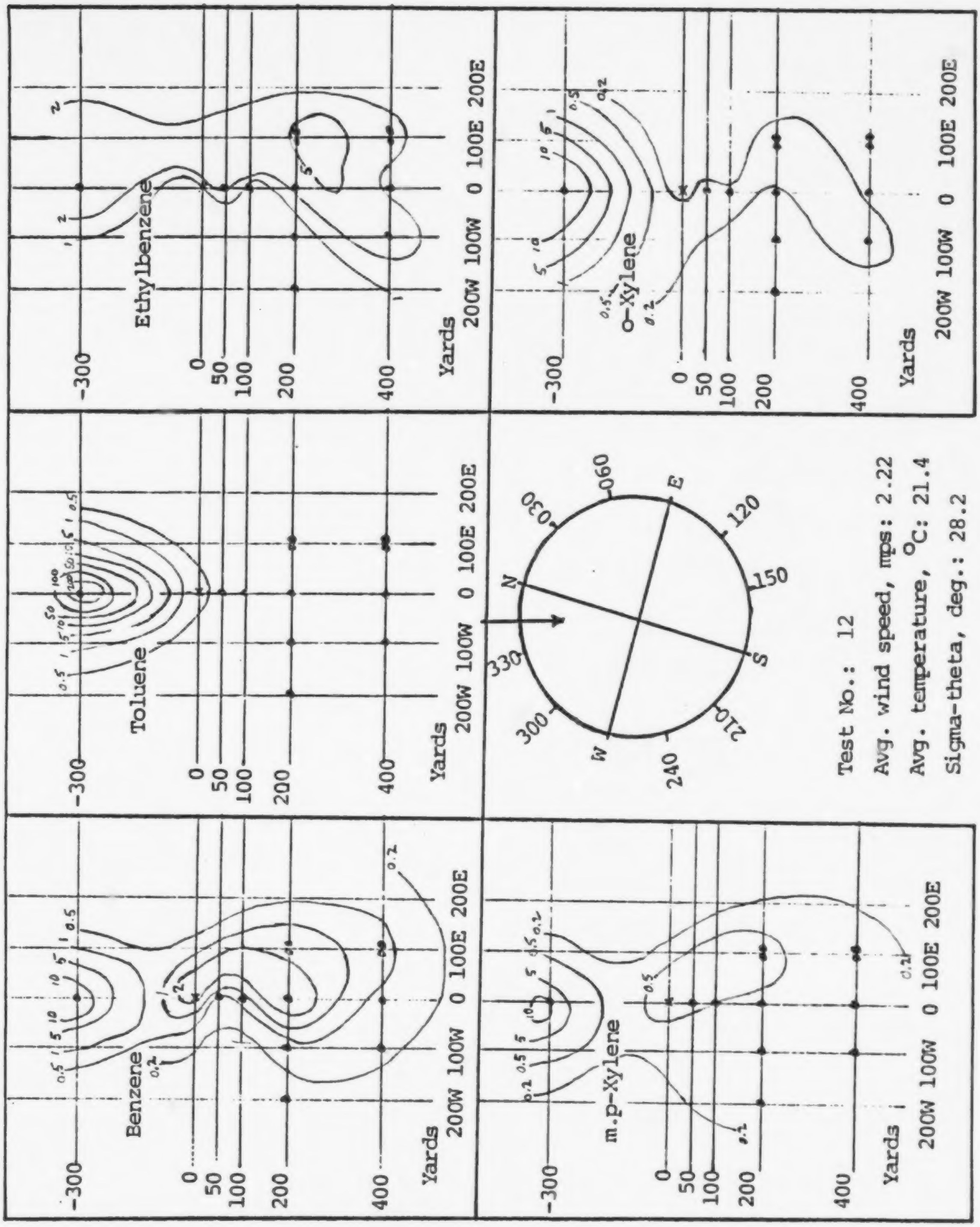


Figure 29. Contour plots for C_{6-8} aromatics, 5-22-86/1800-1830.

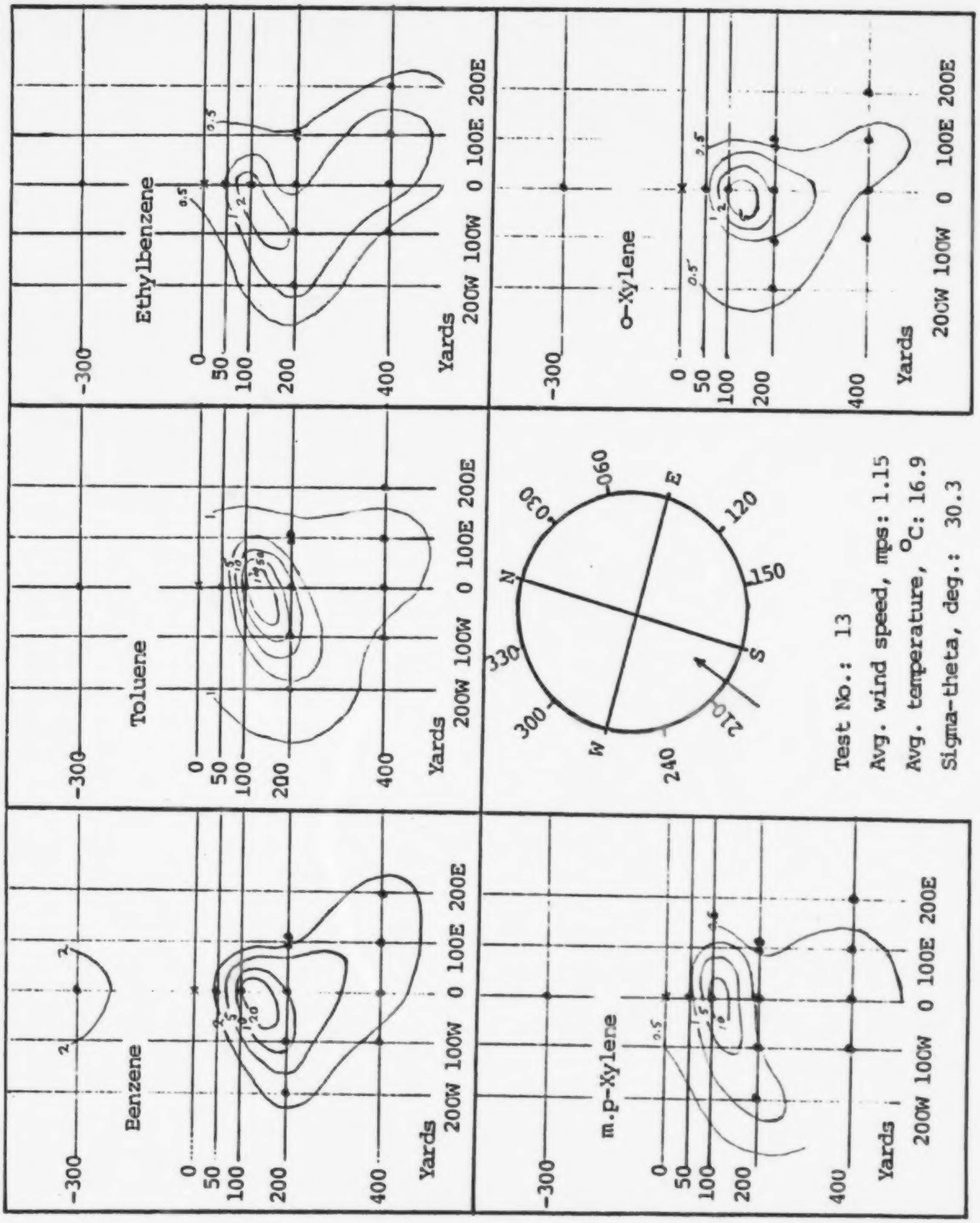


Figure 30. Contour plots for C_{6-8} aromatics, 5-22-86/2020-2050.

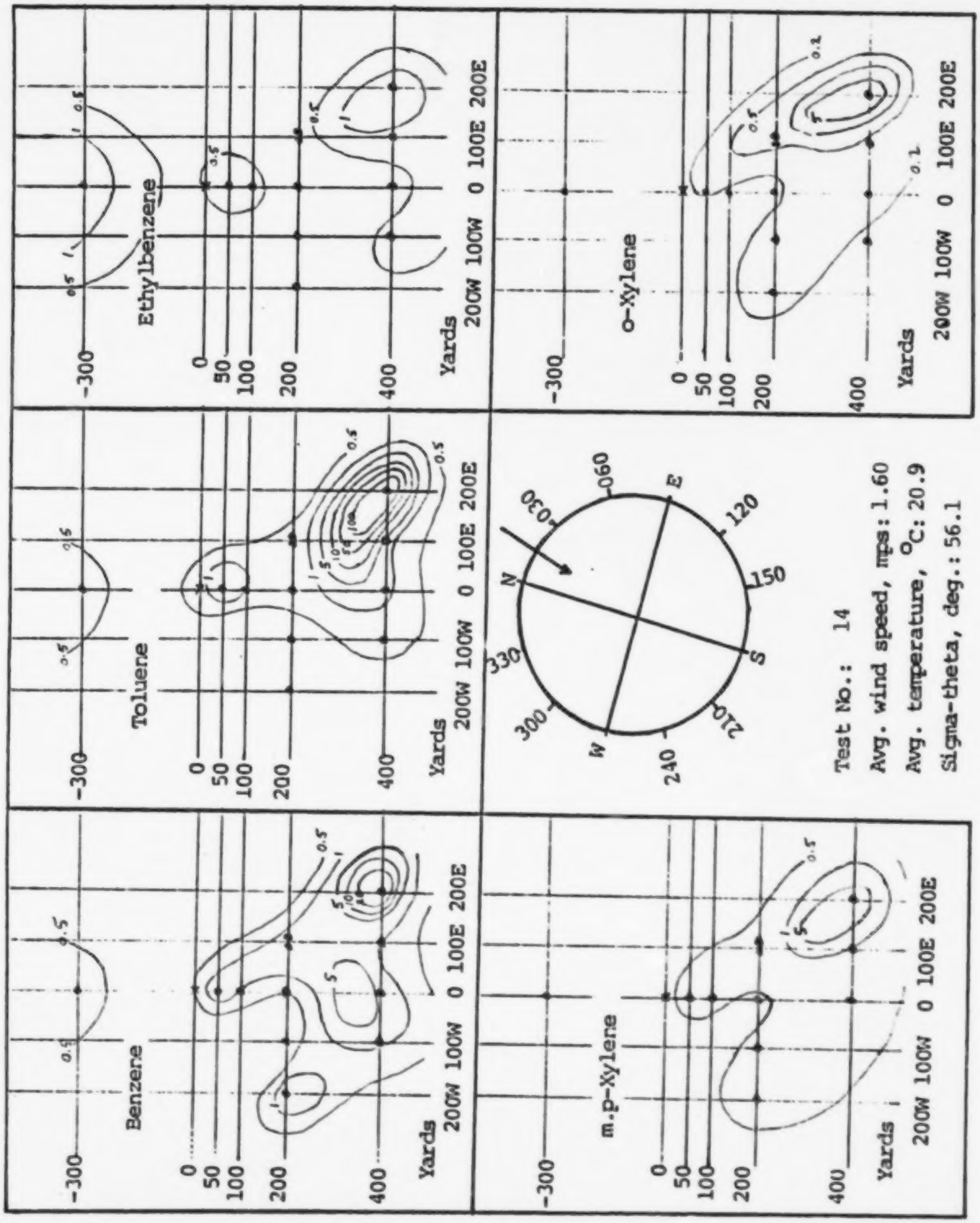


Figure 31. Contour plots for C_{6-8} aromatics, 5-23-86/1050-1120.

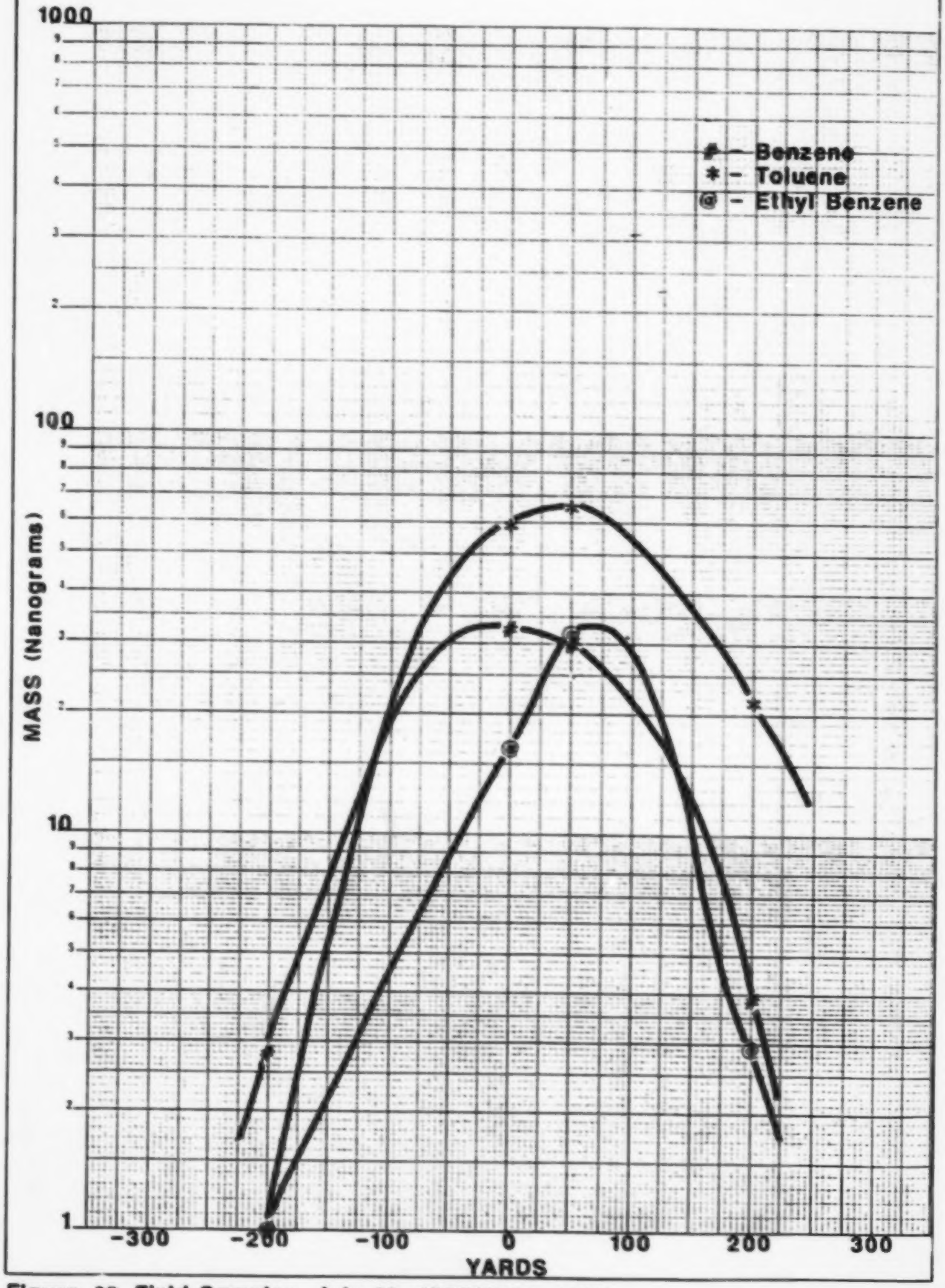


Figure 32. Field Samples, July 10, 1985/1830-1900

Trial 2 - July 11, 1985, 1136-1221

No plot of this sampling run was made, since there are only two sampling locations; one at the origin, and the other, 60 yards downwind. Four samples were taken (two at each sampling point). Benzene concentrations are consistent, with similar values for co-located samples, and indicate a general decrease to about half the source values at the 60 yard downwind distance. However, there are substantial inconsistencies in the toluene and ethyl benzene samples, with decreases in concentration with distance from the source in some cases, and increases in others.

Trial 3 - July 11, 1985, 1250-1320

No plot of this sampling run was made, since there are only two sample distances; one at the origin, and the other, 60 yards downwind. All sample concentrations are consistent with relatively rapid dispersion, and could be used for defining Gaussian and receptor model parameters. Slight differences between co-located samplers exist, but are insignificant.

Trial 4 - July 11, 1985, 1431-1501

Sample concentrations at the origin (waste pond) are missing for this sampling run, and plume behavior is not at all apparent, so data from this test cannot be used. See Figure 33.

Trial 5 - July 11, 1985, 1605-1635

This sample run proved to be the best of all trials. Sampling point data are consistent among the measured species throughout, with similar distributions with distance for each component. These data appear to be the most useful of those obtained in relating Gaussian to receptor model behaviors. See Figure 34.

Trial 6 - September 5, 1985, 1910-1940

Sampling data are inconsistent, with benzene concentrations at the origin almost an order of magnitude higher than concentrations of toluene and ethylbenzene. In addition, there is a sharp drop in concentration 50 yards downwind, followed by an increase at 100 yards. It is suspected that there was a bad sample at the 50 yard point, perhaps caused by insufficient air flow. If the concentration is accurate, downwind bi-modal distribution is indicated, due to a plume elevated above ground level at 50 yards, returning to ground level again at 100 yards. Data from this sampling run are not useful for modelling. See Figure 35.

Trial 7 - May 20, 1986, 1855-1925

Data collected during this field trial are internally very

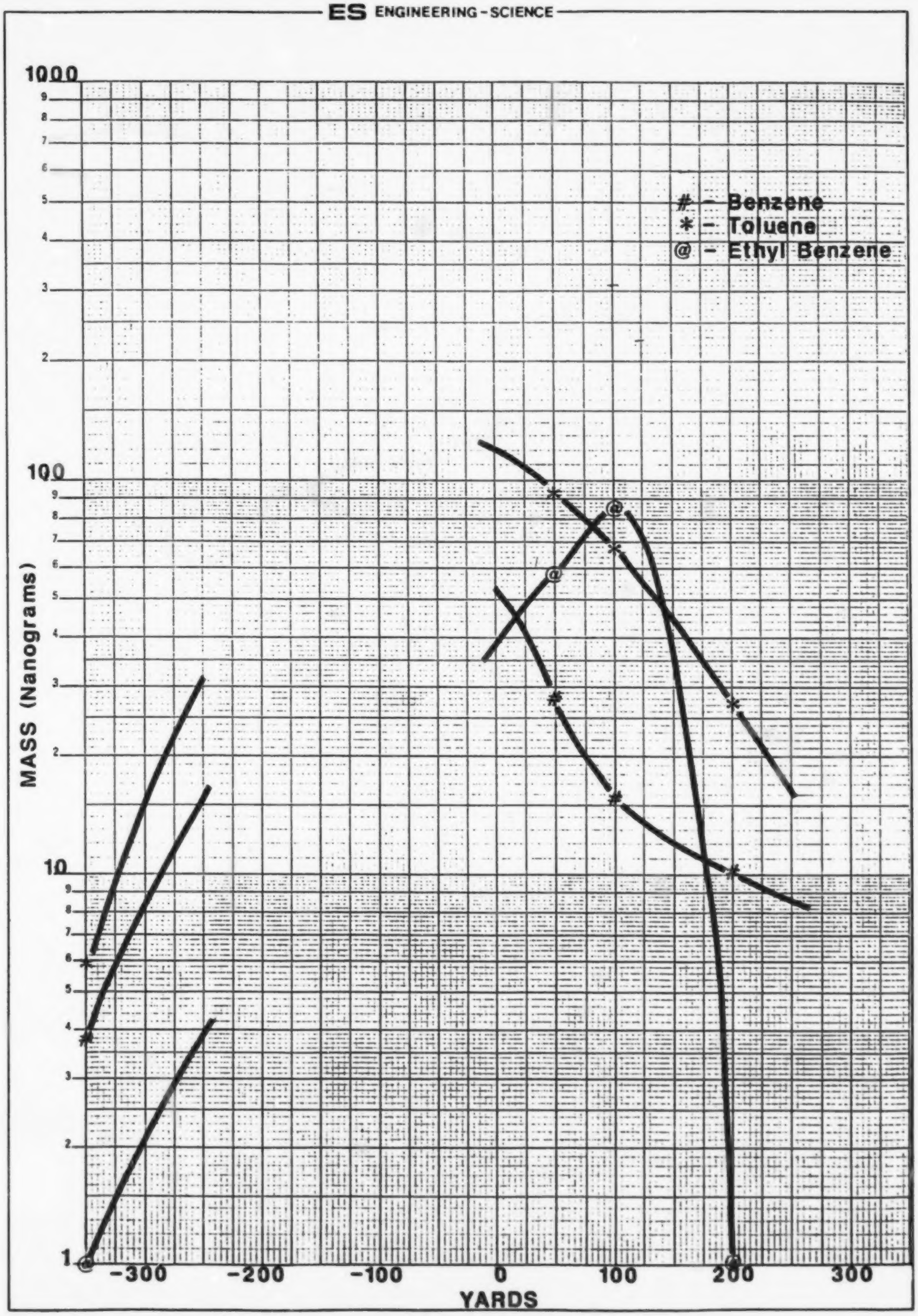


Figure 33. Field Samples, July 11,1985/1431-1501

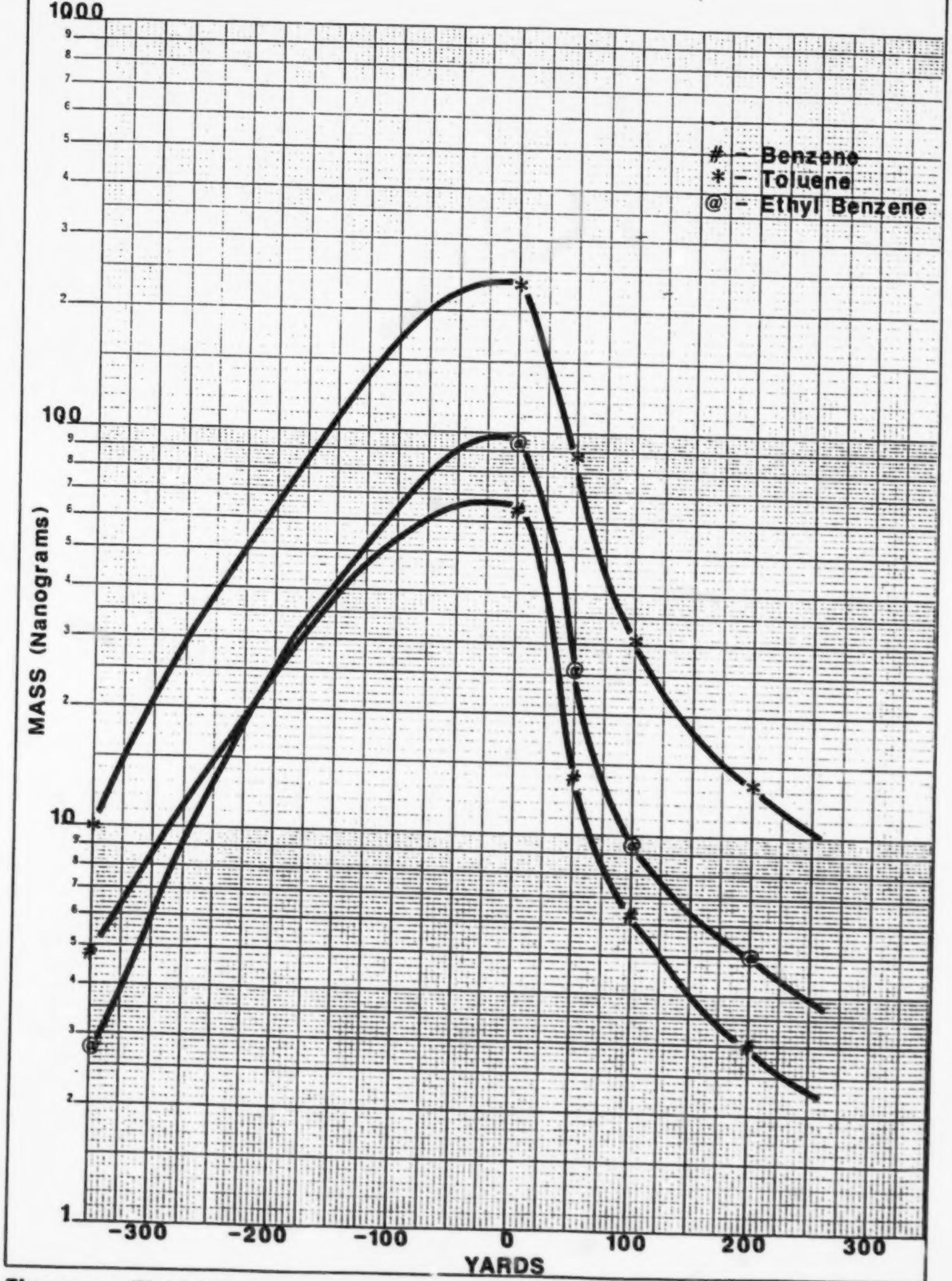


Figure 34. Field Samples, July 11, 1985/1605-1635

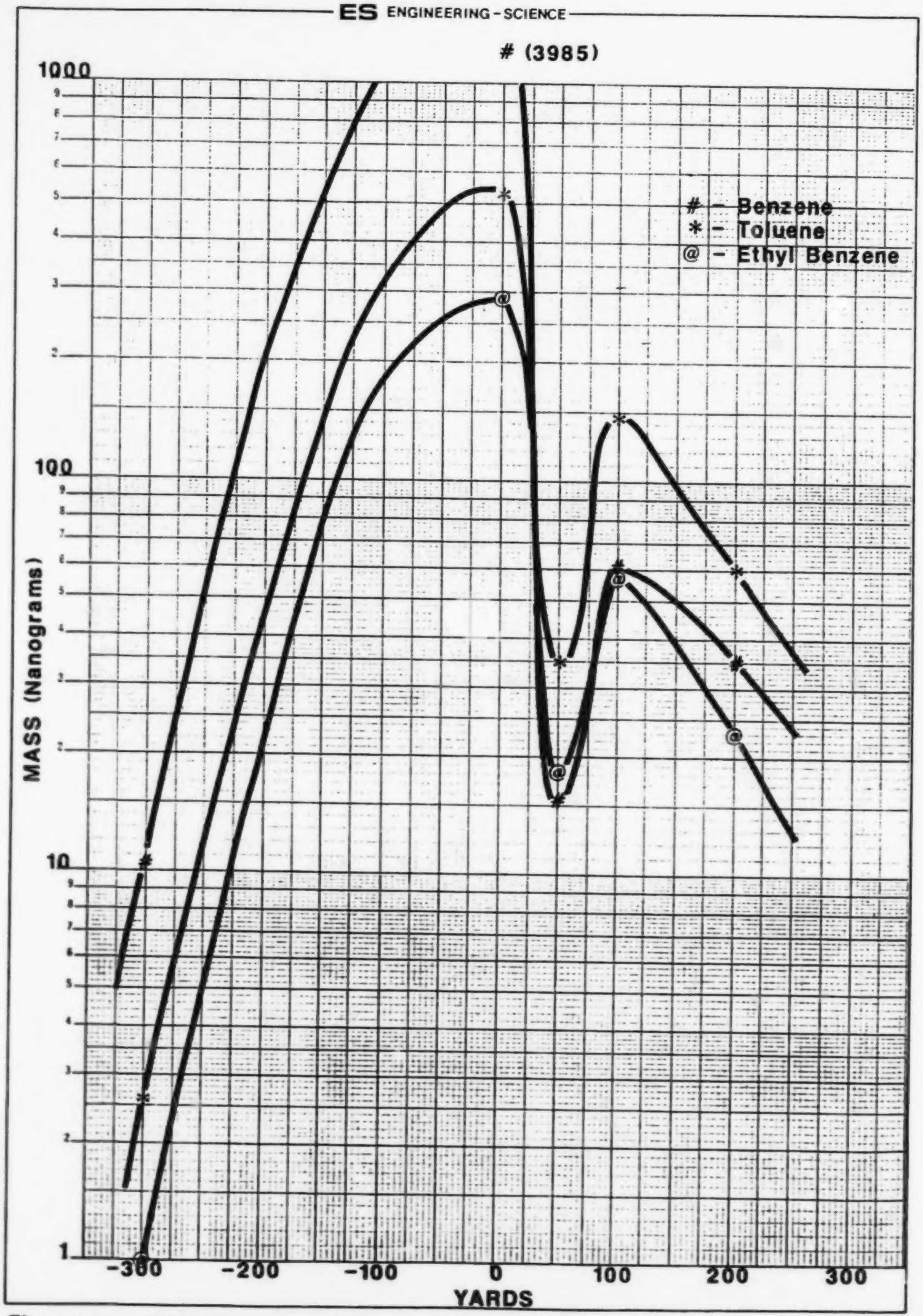


Figure 35. Field Samples, Sept. 5, 1985/1910-1940

consistent, with all five species exhibiting quite similar behavior from upwind to downwind along the grid centerline. All species show low values from the upwind point to the central point, then a very marked and abrupt peak at the 50-yard point, followed by an equally rapid decline. The magnitude of the peak at 50 yards downwind is somewhat surprising, as is the rapid rise and equally rapid decline in concentrations upwind and downwind. However, as can be seen from Figure 36, the data are internally consistent, with all species exhibiting similar behavior during the trial.

Trial 8 - May 21, 1986, 1145-1216

Data again show internal consistency, although not as cohesively as in Trial 7. There is, as can be seen in Figure 37, a gradual rise in concentrations from the upwind sample to the zero point, followed by a decline at 50 yards, another minor rise, and finally a gradual fall in values. Concentrations are generally within an order of magnitude at each sampling point.

Trial 9 - May 21, 1986, 1300-1330

Data collected during this trial are highly irregular, and do not exhibit any discernible pattern. Peak concentrations of individual species occur at different downwind locations (see Figure 38), and vary substantially in magnitude. Sampling data from this field trial serve to confuse the issue rather than clarify it.

Trial 10 - May 21, 1986, 1540-1610

Sampling data are again reasonably consistent, with all species exhibiting a peak, this time at the central zero point, or supposed origin. This produces the expectation that dispersion behavior is in accordance with accepted principles (see Figure 39), and this sampling trial is indeed one of the better results produced during this project.

Trial 11 - May 21, 1986, 1745-1815

Like data from Trial 9, data for this trial are highly irregular and confused, and do not provide any discernible useful information. Results are suggestive of different sampling period results, with peaks and valleys at different downwind distances for each species. See Figure 40 for downwind concentrations by distance.

Trial 12 - May 22, 1986, 1800-1830

Sampling data for this field trial are especially confusing (see Figure 41), inasmuch as maxima for all species occur at the upwind sampling location. Additionally, there are almost two

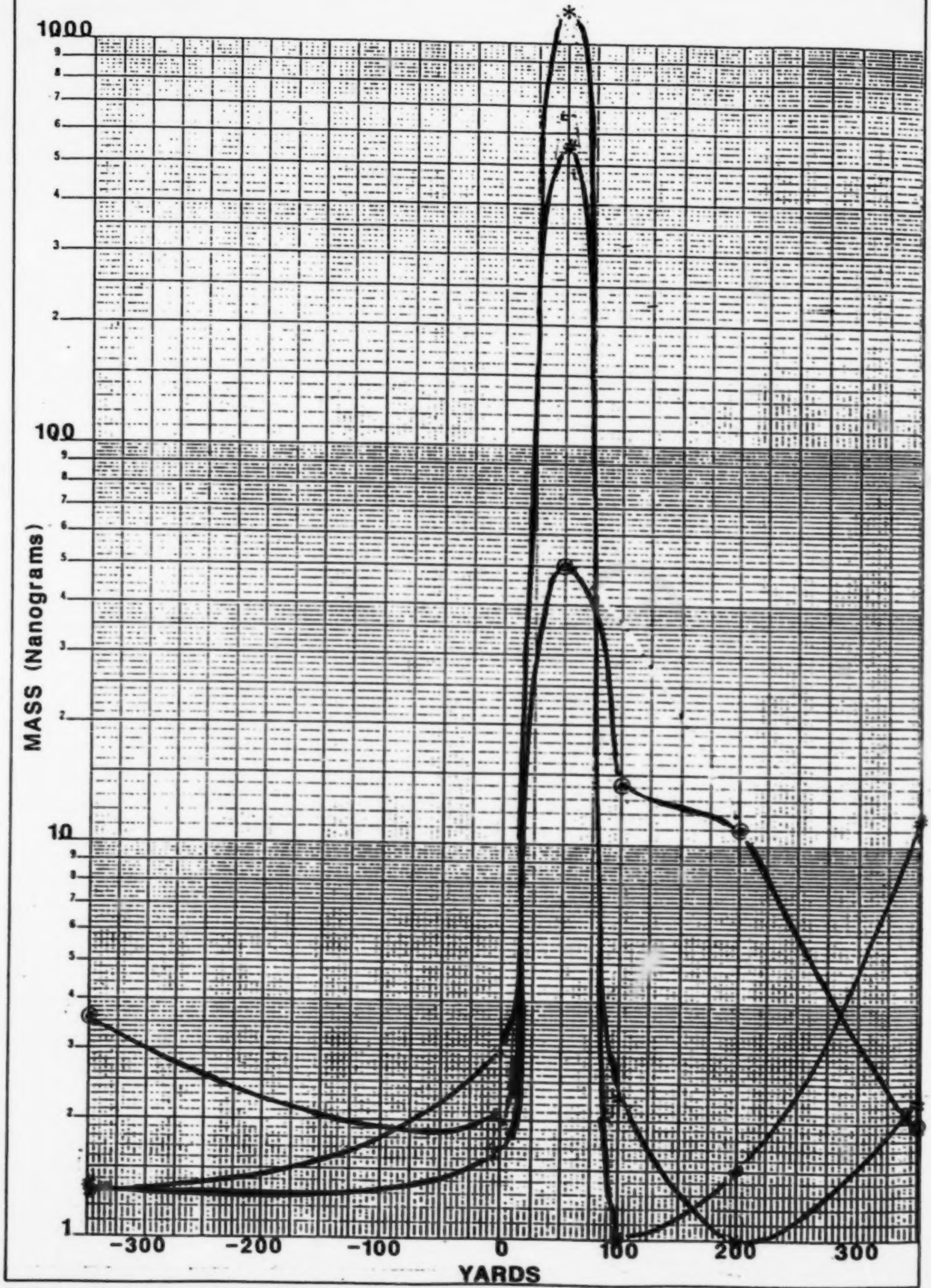


Fig. 36. Field Samples, May 20,1986/1855-1925

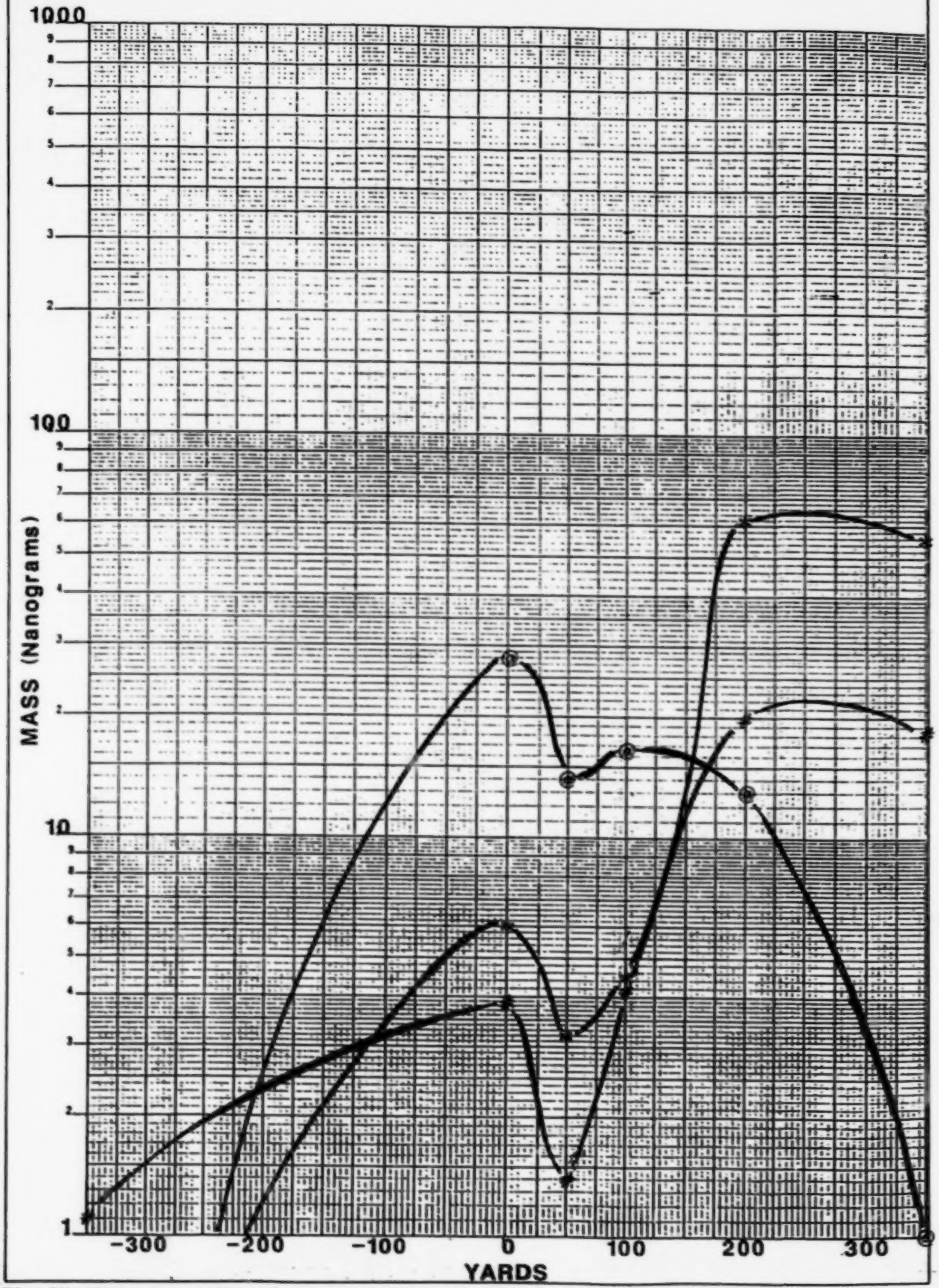


Fig. 37. Field Samples,May 21,1986/1145-1216.

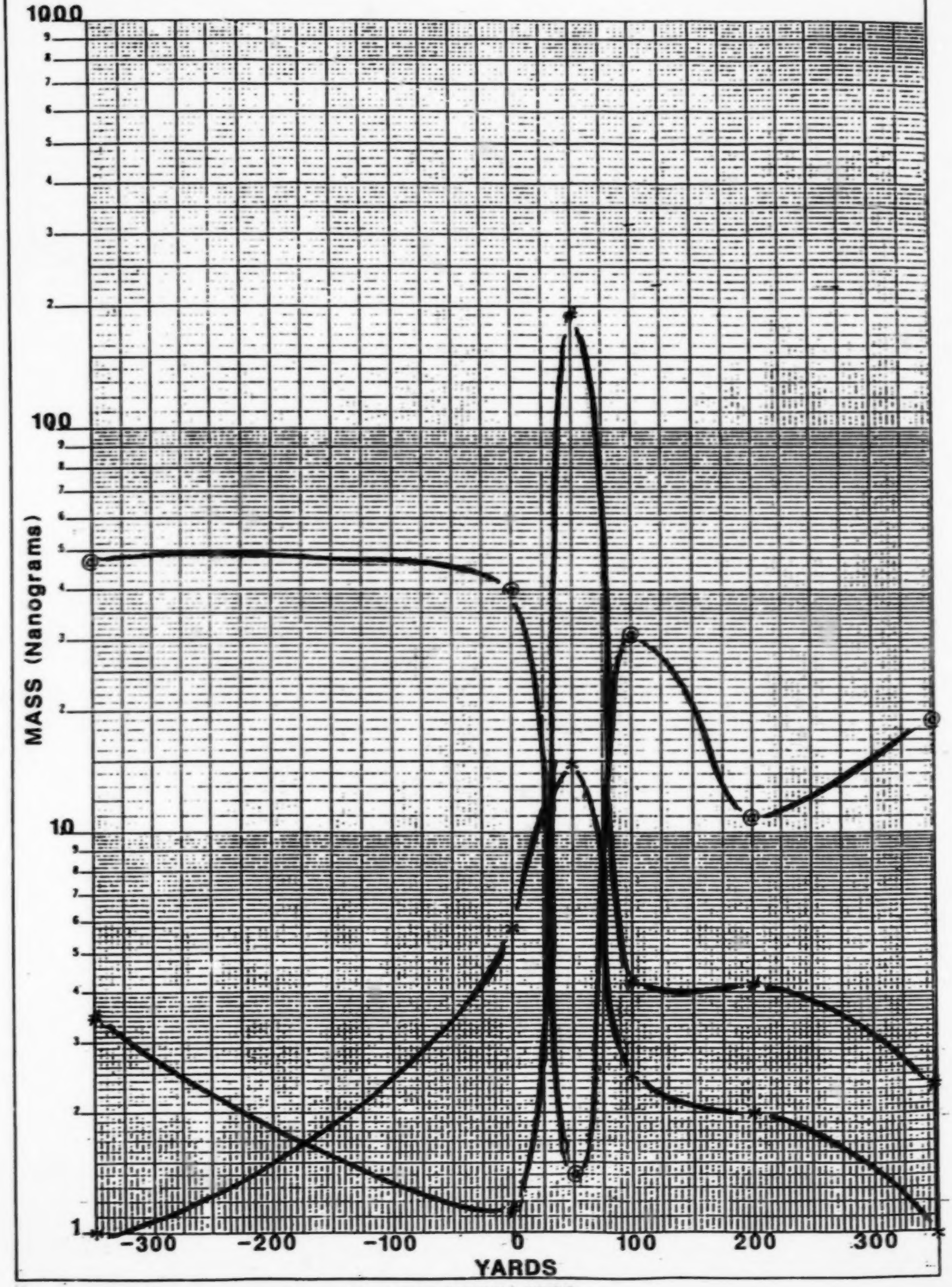


Fig. 38. Field Samples, May 21, 1986/1300-1330

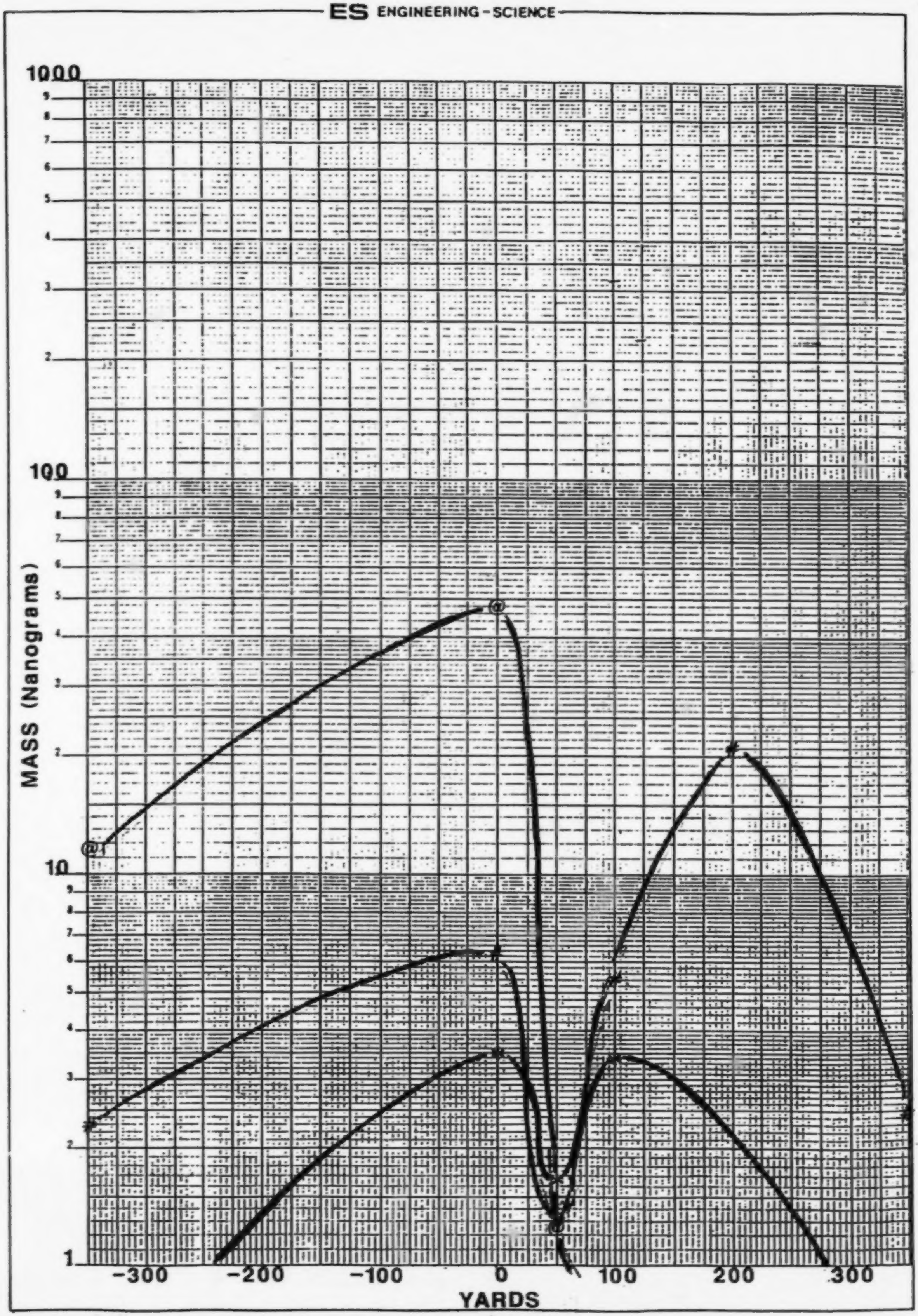


Fig. 39. Field Samples, May 21, 1986/1540-1610

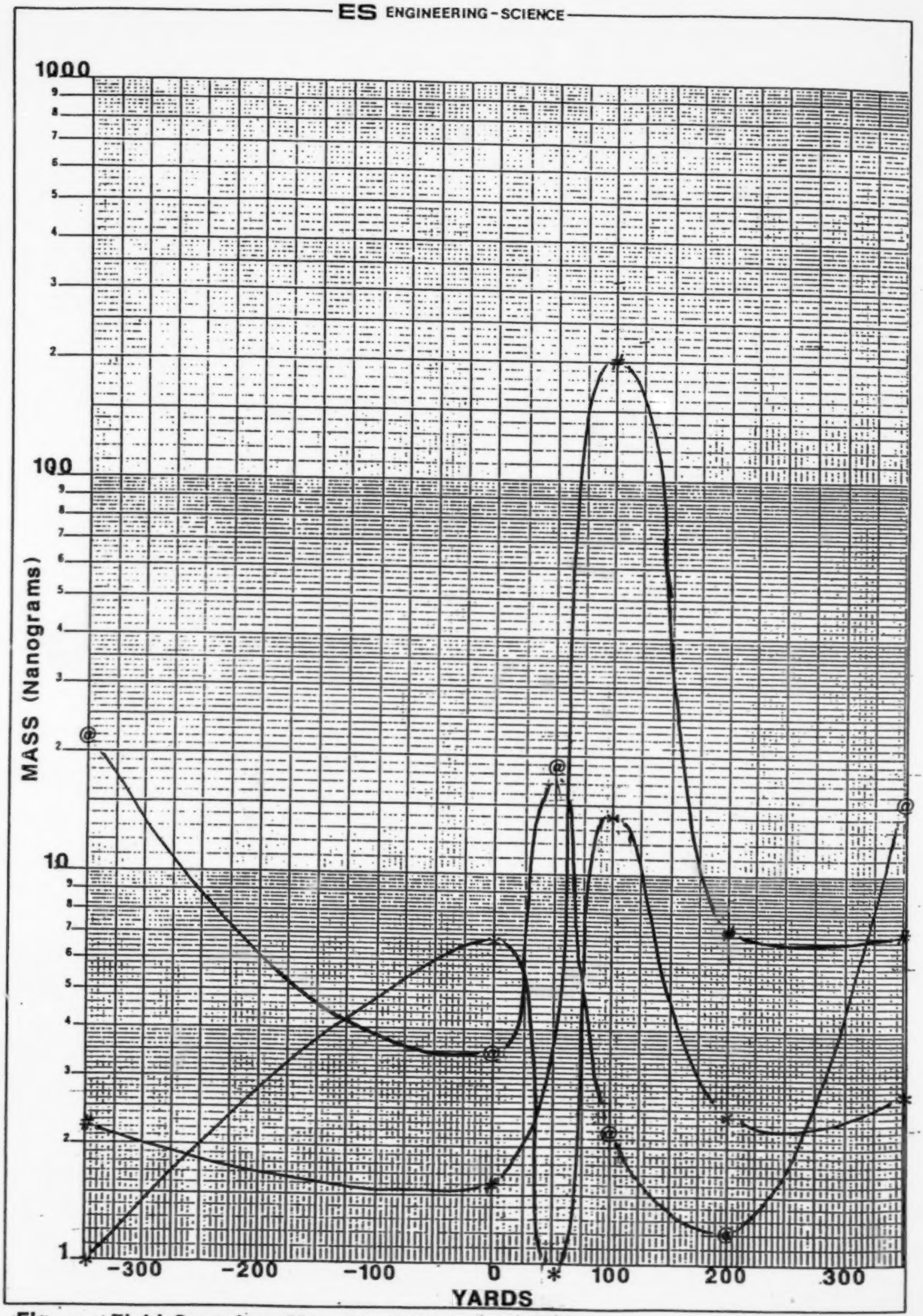


Fig. 40. Field Samples, May 21, 1986/1745-1815

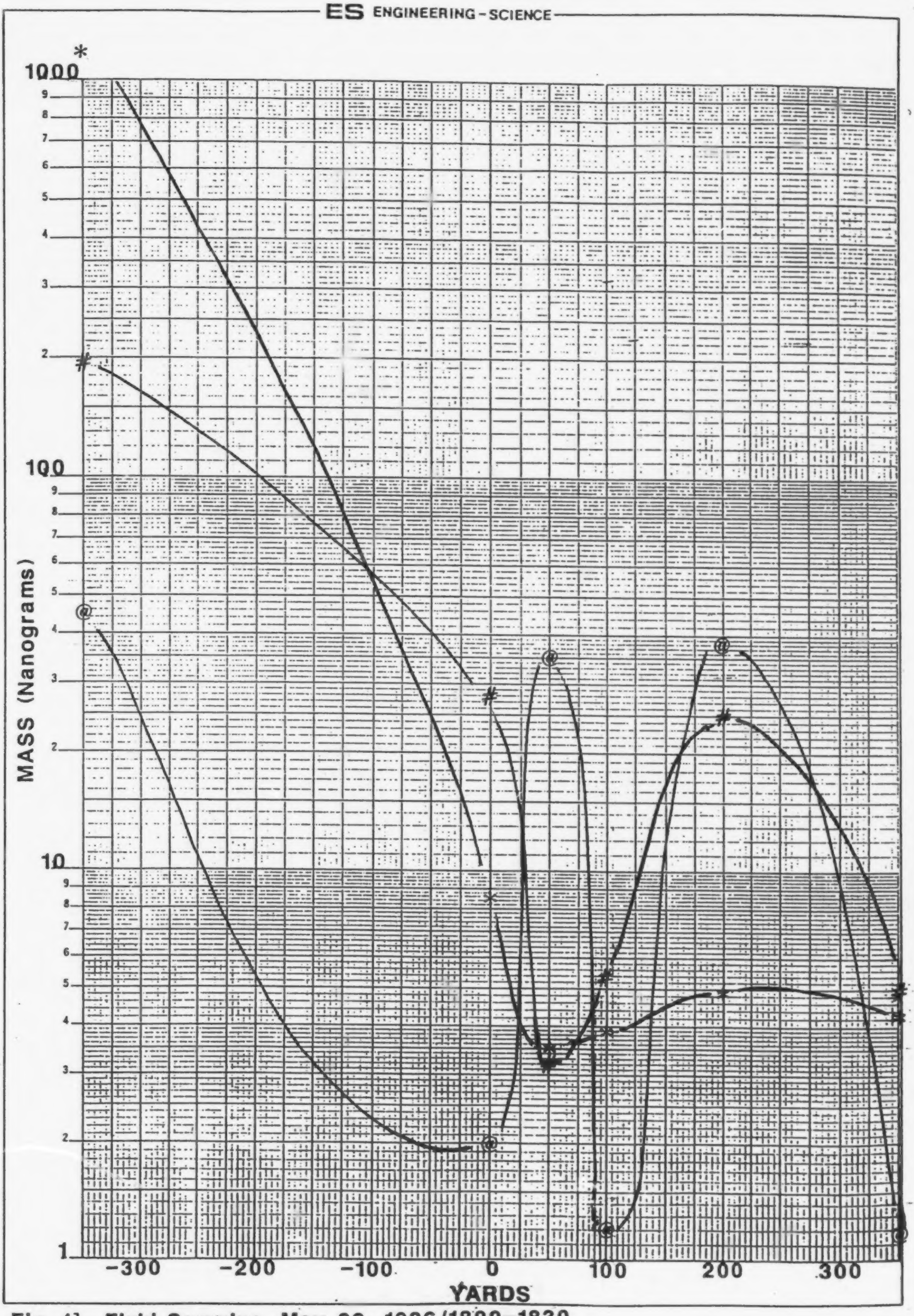


Fig. 41. Field Samples, May 22, 1986/1800-1830

orders of magnitude difference between the highest and lowest maxima. As another complication, values for ethylbenzene reached two distinct and separate lesser peaks downwind of the zero sampling point, with other species exhibiting single secondary peaks at downwind locations. Interpretation of these sampling results is certainly difficult.

Trial 13 - May 22, 1986, 2020-2050

Data within this set are internally consistent, and lend themselves to some reasonable interpretation. There is, however, a discernable low point among all species at 50 yards downwind. Nevertheless, all species exhibit maximum values (see Figure 42) at 100 yards downwind, and values drop off from the peak with a reasonable approximation of expected atmospheric behavior. This sampling series promised to be one of the more valuable sets of data.

Trial 14 - May 23, 1986, 1050-1120

Data from this trial did not show, from centerline samples, much indication of being very useful. Sample values were basically in the same range from upwind locations to downwind, some 700 yards apart. A minor peak is suggested at 50 to 100 yards downwind of the zero point (see Figure 43). However, the flatness of the concentration curves of all species appeared discouraging for functional data analysis.

(B) ANALYTICAL METHODOLOGIES

The contract under which this field and analytical work was performed for EPA suggests that the following efforts would be made:

> The objective of this project was to examine the atmospheric chemical and physical removal processes affecting one or more selected hazardous air pollutants as a means of determining source-receptor relationships. Two modeling approaches were to be applied to the field measurements. Depending on the reactivity of the hazardous pollutants, one or both of these techniques were to be applied to each hydrocarbon species.

Gaussian Model

The relatively stable and/or predictable hazardous compounds were to be modeled with a Gaussian model modified for deposition velocity and reactivity. ES considered using several photochemical pollutant models available from EPA; however, their chemical transformation algorithms were not adequate for the spectrum of hazardous compounds examined, and for the sampling distances involved in this project. The sampling distances, limited by the instrument range, the physical restrictions of the

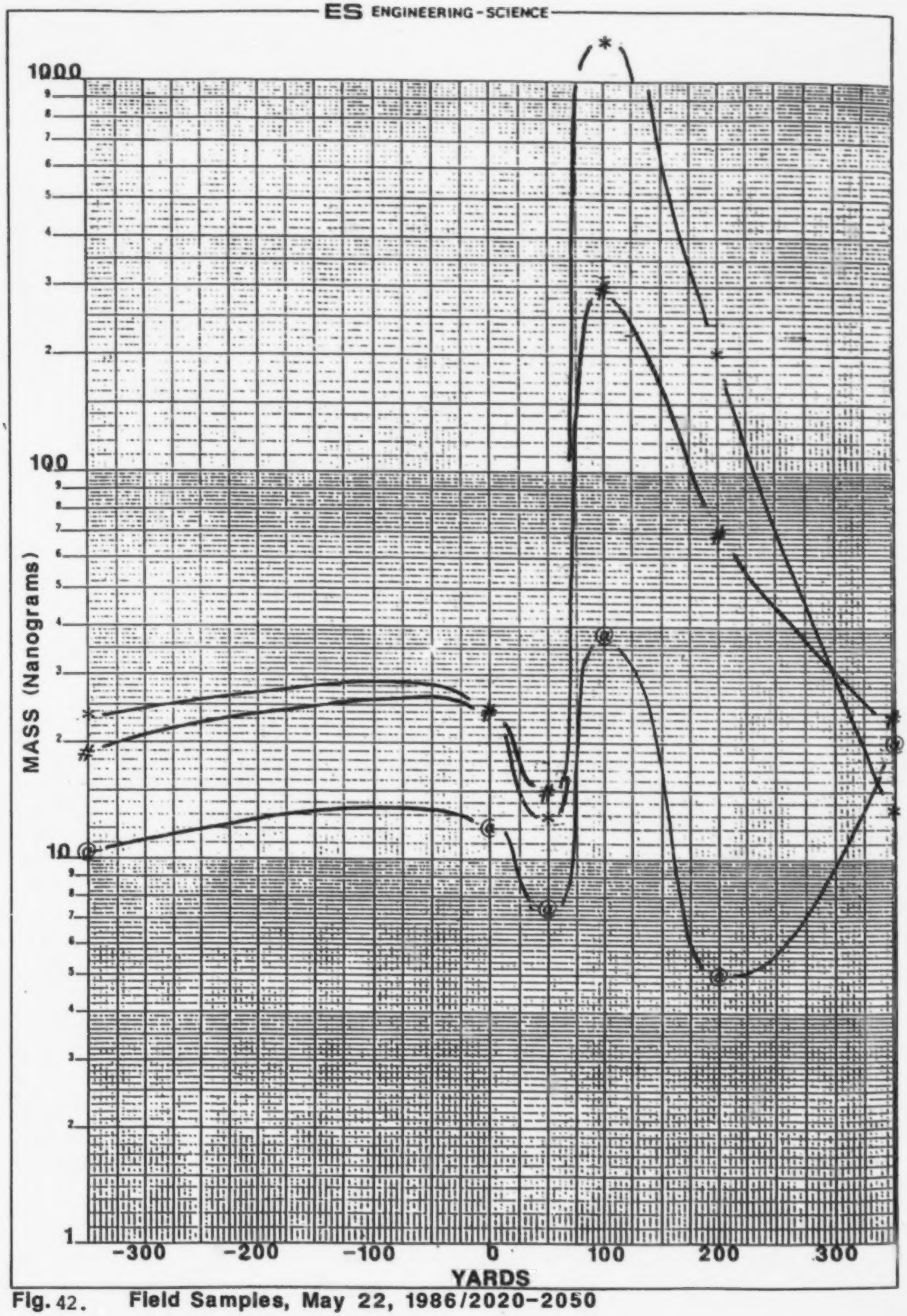


Fig. 42. Field Samples, May 22, 1986/2020-2050

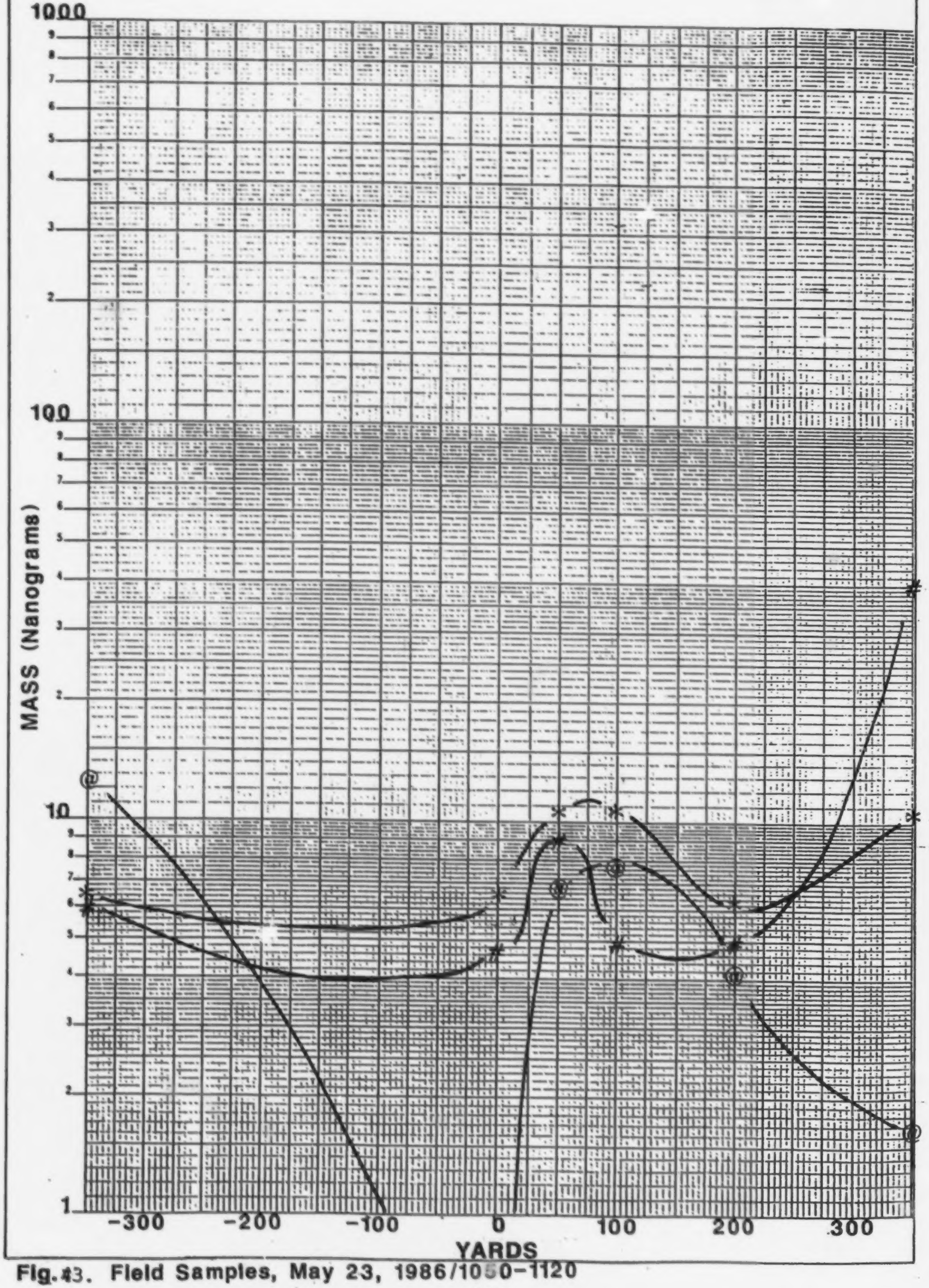


Fig. 43. Field Samples, May 23, 1986/1050-1120

site and the personnel availability, were considered to be unsuitable for the algorithms of transformation, and accordingly not entirely appropriate for this application.

A modified Gaussian puff model was applied to the measured data along with the concurrent data on meteorological conditions necessary for modeling (wind speed, wind direction, and stability class) and appropriate reaction rate constants for the selected hazardous compound. This integrated chemical method accounts for the fact that the reactive species may take several minutes to reach equilibrium with other reactive constituents within the plume and ambient air.

The model equations were to be solved numerically using experimental measurements obtained from the field study program. The results were to be presented in the form of plots of predicted vs. observed concentrations and least-squares curve fits determined.

Receptor Model

A receptor model estimates the contribution of specific sources or source categories to ambient concentration levels by relating the characteristics of the source emissions to the characteristics of the pollutants collected at the sampling site.

Receptor models have been successfully applied to source apportionment of particulate matter. Only a limited amount of research has thus far been conducted on applying receptor models to volatile organic gases. Chemical Mass Balance (CMB) and factor analysis are two receptor-modeling approaches that have gained use and success with particulate matter. Both approaches have severe limitations when applied to gaseous substances. The main limitation of both CMB and factor analysis is that they require relatively non-reactive pollutnts for proper application. To study reactive hazardous pollutants, adjustments to the models are required.

Two methods of adjustment appeared promising and have been considered:

- The use of a "decay factor" to account for reactions of the pollutants. This method requires the choice of an arbitrary reaction parameter, K, so that the conversion of a species can be expressed in a single step. The important assumption in this method is the arbitrary experimental decay factor dependent upon the nature of the chemical species.

- The use of "surrogate" non-reactive pollutants such as benzene and estimates of emission ratios between the reactive pollutants and the surrogates. This method provides a worst-case estimate of the impact of gaseous substances.

For CMB, source "fingerprints" that express the relative contribution of each gaseous toxic substance must be developed and all emissions in the CMB analyses must express these fingerprints as a percent of the total mass of the given set of common substances. The receptor modeling approach was to consist of a CMB technique modified by use of decay factors or surrogate pollutants.

(C) MODELING RESULTS

Extensive attempts were made to resolve the sampling data sufficiently to determine source-receptor relationships and physical/chemical processes. A number of approaches were tried to better understand atmospheric processes as they relate to sampling results, both on an actual and a theoretical basis. Indeed, a variety of approaches were followed in trying to relate sampling results of hydrocarbon species to possible Gaussian dispersion processes in the atmosphere with respect to the waste ponds at the Taft site. In particular, plots of hydrocarbon species concentrations versus spatial sample distributions were made (see Figures 24-31, above), and attempts made to relate concentrations to possible upwind source terms in accordance with expected atmospheric behavior under a variety of wind and stability conditions.

A total of fourteen field tests were conducted in 1985 and 1986. The latter series of 1986 field tests, using a larger number of samplers and an integrating anemometer, was expected to provide better resolution of sampling data and improved relationships between Gaussian and receptor models. Close examination of sampling results and wind/stability data, however, indicated poor or non-existent correlations. Sampling data were often internally consistent between selected hydrocarbon species in magnitude of concentrations, but nevertheless exhibited extensive irregularity in these magnitudes from test to test, and indicated no pattern of regular behavior when viewed as a function of wind direction. For example, Trial number 7 (Figure 24), with a west wind (crosswind to the evaporation ponds) showed peak concentrations at 50,0 (50 yards south of grid center on the centerline) and at 100,100E (100 yards south, 100 yards east of centerline) for all five species. Trial number 13 (Figure 30) showed consistent peaks for all five species at the 100,0 point with a south-southwest wind blowing toward the waste ponds from the sample grid. In neither case was there an apparent source upwind of the sample grid. The remainder of the field trials in 1986 showed specific peaks within the sampling grid. The exception to this was Trial number 12 (Figure 29), where the sampler maximum was found in an upwind position (-300,0) to the wind direction.

Table 46. Maximum Concentrations ($\mu g/m^3$)

Trial	Benzene	Toluene	Xylenes,etc.[a]
7	191.0	751.0	180.0
8	8.0	24.4	45.0
9	79.0	5.0	164.4
10	159.2	229.1	30.3
11	79.6	8.1	14.1
12	9.6	1.9	26.0
13	113.0	1164.0	93.7
14	121.8	628.6	67.5

[a] : includes ethylbenzene and m-,p-, and o-xylenes; grouped because of identical molecular weights.

Table 47. Equivalent Emissions (g/s)

Trial	Benzene	Toluene	Xylenes,etc.[a]
7	0.064	0.253	0.061
8	0.222	0.681	1.271
9	2.600	0.163	5.360
10	3.750	5.390	0.713
11	0.127	0.013	0.023
12	0.227	0.045	0.616
13	0.598	6.160	0.496
14	7.240	37.400	4.010

[a] : ethylbenzene, m-, p-, and o-xylenes combined.

Table 48. Equivalent Emissions Ratios

Trial	Toluene/Benzene	Xylenes/Benzene
7	3.95	0.95
8	3.07	5.73
9	0.06	2.06
10	1.44	0.19
11	0.10	0.18
12	0.19	2.71
13	10.30	0.83
14	5.17	0.55

During analysis of modeling results, several approaches were attempted. The most promising of these was an effort to relate maximum contrations found during each 1986 sampling test to a corresponding source term through use of a Gaussian dispersion relationship. Table 46 below shows maximum concentrations for the 1986 data. It may be observed from Table 46 that concentrations vary considerably from trial to trial. Furthermore, the ratio of one species to the other varies substantially throughout the sampling period. Thus, there seems to be no close relationship between hydrocarbon species and their measured concentrations in the field trials.

Measured concentrations were also taken as being representative of those from an upwind source, and, with wind speed, wind direction, and an approximation of atmospheric stability, were fitted by Gaussian methods to simulate an upwind source term. Results of these efforts are shown in Table 47, above. Again, as may be noted from this table, there is no clear or apparent relationship between individual species during each trial, or between the same species during different trials. The equivalent emissions necessary to produce the concentrations measured during each trial is seen to vary by as much as several orders of magnitude (e.g., toluene, trials 11 and 14).

Given the short travel time of the plume to the samplers, it was doubtful that significant chemical reactions of the emitted species would be expected. The use of a CMB receptor model modified by means of and arbitrary reaction parameter, K, is probably not appropriate for the field data collected in this study.

The equivalent emissions calculated in Table 47 for benzene, toluene, xylene etc, can be used to provide estimates of emission ratios between reative pollutants and the non-reactive surrogate (i.e. benzene). Equivalent emission ratios are shown in Table 48 (above). It is readily seen that the toluene/benzene and xylene/benzene ratios are not at all consistent, and in fact vary substantially from one trial to the next. It had been hoped that some thread of consistent behavior could be found in these data, but the variability of the emission ratios is well outside expected behavior for a single emission source, and further indicate the existence of other strong and variable sources of these materials external to the waste ponds. Emissions from the ponds, presently inactive, would be expected to be relatively constant and uniform over each sampling period, varying only with solar heating and wind speeds. Such was definitely not found to be the case.

Over-all, despite efforts to fit field sample data to either Gaussian or receptor models, no reasonable or logical method was found. The study results instead point to substantial background levels of the sampled species from a number of unknown sources in the nearby area. The interference of these other sources is sufficiently strong to overwhelm any concentrations which may have been measured from the waste ponds. As a result of these strong interfering factors, it has not been possible to decipher and extract from the sampling data any consistent relationship between source and receptor, or between Gaussian and receptor models.

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APPENDIX A: QA/QC PROCEDURES

A-1.0 Tenax Cleanup Procedure

After selection of the Tenax trap collection procedure, the commercially available tubes (SKC; 100mm x 8mm glass with 0.15g 20/40 mesh Tenax) were tried. It was found that the best obtainable quality had an unsatisfactory high background (Figure A-1). A manifold consisting of a cylindrical brass tube with 26 inlets with compression O-ring fittings and a gas inlet was loaded with the tubes (cracked open on each end) and placed in a 250°C oven, while dry nitrogen was passed through the manifold at 30 ml/min. After two hours the background was reduced to an acceptable level (Figure A-2). It was subsequently found that a larger sized trap was desirable to allow higher flow rates, and the manifold was refitted with larger diameter fittings to be used with larger homemade glass tubes. (These were fabricated from 6.35mm o.d. x 15cm glass tubes, loaded with 0.5g Tenax with fiber glass plugs at each end, and drawn out to about 2mm o.d. on each end). The cleanup results were the same. Immediately after purging, each tube was sealed with a torch at both ends. This procedure was adopted after tests of tube storage with plastic caps, in purged vacutainers (septum-capped), and torch-sealing, showed that the latter maintained the most satisfactory background levels (Figure A-3). In the field, each tube was opened by breaking off each end (drawn out to small diameter) just before placing in the sampler inlet. Promptly after sampling, the tubes were resealed with a propane microtorch.

A-2.0 Gas Chromatographic Procedure

After investigating various approaches for desorbing the aromatic compounds of interest from the Tenax traps, the following procedure was developed:

a. Cut off the tube at both ends below the tapered portions, to an approximate length of 12cm with uniform o.d., slip the heater jacket over it, and connect it to the desorption unit (Figure A-4) with Vespel ferrules as quickly as possible to minimize exposure to laboratory air.

b. Leak check all fittings.

c. Switch the six-way SS valve of the desorption unit to the"PURGE" position and purge the tube with high purity nitrogen at 30 ml/min for three minutes (i.e. 18 Tenax bed volumes) at room temperature to remove any laboratory air that may have diffused into the tube.

d. Switch the six-way valve to the "CLOSED-LOOP" position.

e. Turn on the jacket heater transformer at maximum output.

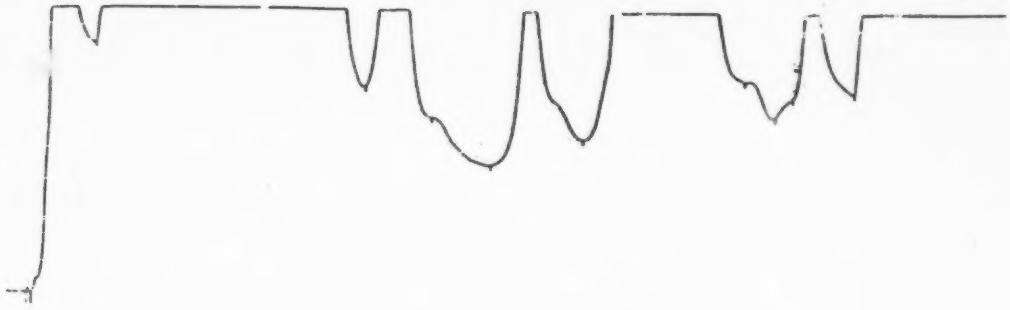


Figure A-1. Gas chromatogram of untreated Tenax cartridge (commercial source).

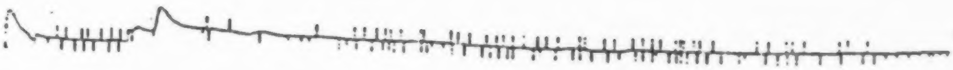
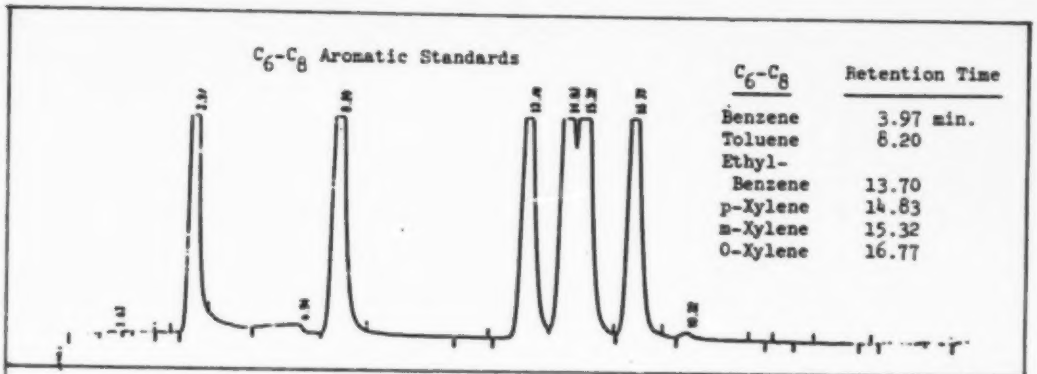
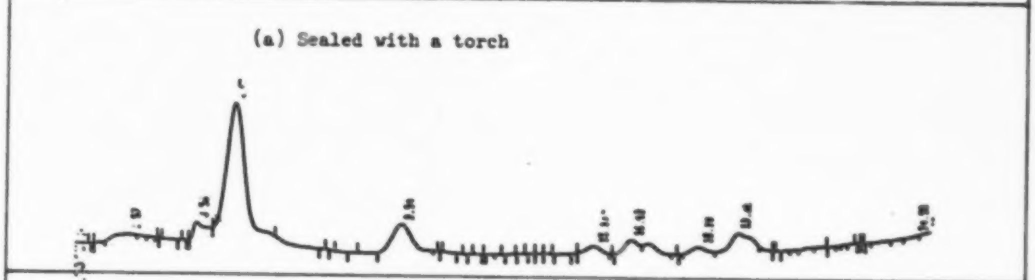


Figure A-2. Gas chromatogram of Tenax cartridge purged at 250°C with 30ml/min nitrogen carrier gas for 2 hours.

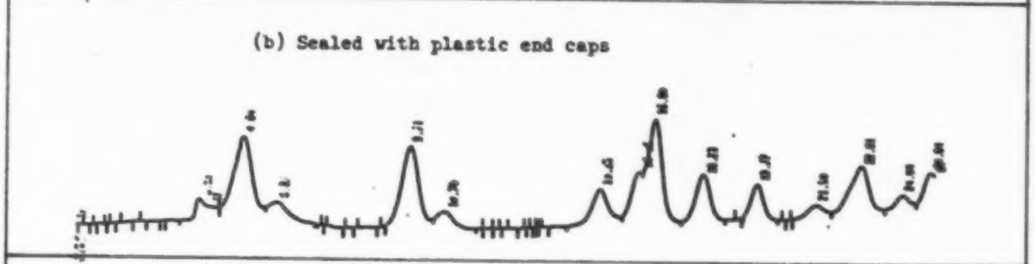


C_6-C_8 Aromatic Standards

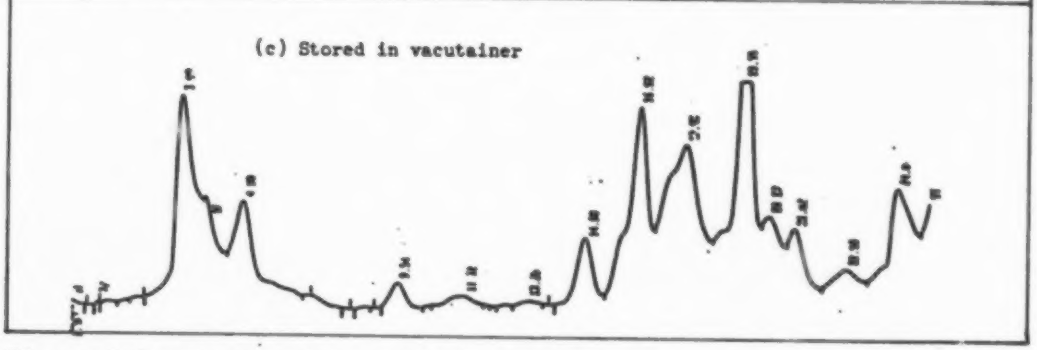
C_6-C_8	Retention Time
Benzene	3.97 min.
Toluene	8.20
Ethyl-Benzene	13.70
p-Xylene	14.83
m-Xylene	15.32
O-Xylene	16.77



(a) Sealed with a torch



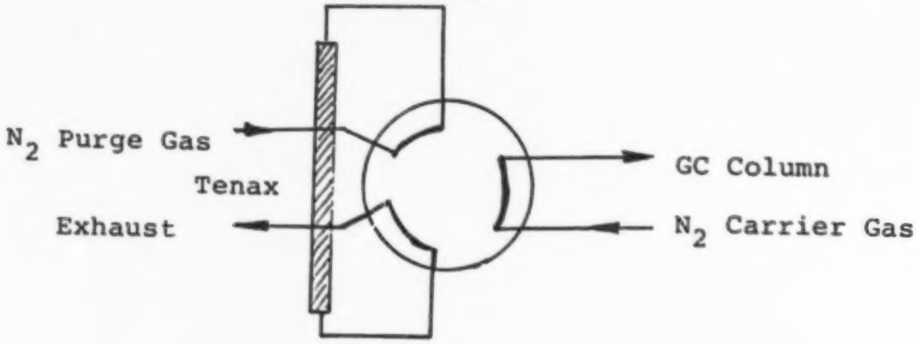
(b) Sealed with plastic end caps



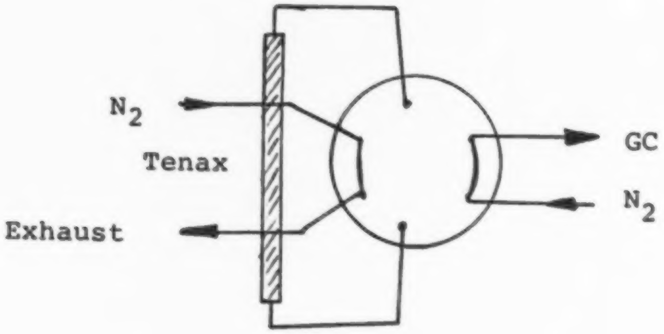
(c) Stored in vacutainer

Figure A-3. Gas chromatograms of C_6-C_8 aromatic standards and Tenax cartridges sealed by one of three different methods and stored 24 hr in a desiccator.

PURGE


N_2 Purge Gas
Tenax
Exhaust
GC Column
N_2 Carrier Gas

CLOSED-LOOP


N_2
Tenax
Exhaust
GC
N_2

DESORB

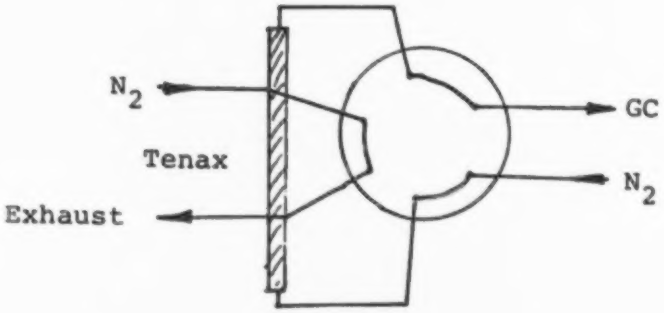

N_2
Tenax
Exhaust
GC
N_2

Figure A-4. Schematic of thermal desorption unit with 6-way valve for Tenax cartridge.

f. Switch the six-way valve to the "DESORB" position and backflush the tube contents onto the GC column with nitrogen carrier gas for four minutes at 30 ml/min (it requires about two minutes to raise the temperature of the tube from ambient to 250°C).

g. Switch the six-way valve to the "PURGE" position.

h. Shut off the heater transformer and remove the tube when cool.

The GC conditions were as follows:

Column: 6ft 5% SP-1200 + 1.75% Bentone-34 on 100/120 mesh Supelcoport, glass column.
Carrier gas: High purity nitrogen at 30ml/min.
Injection port: 180°C.
Detector: Photoionization at 220°C.
Oven temperatures: Initial 50°C for 6 min (4min for desorption), then increase to 90°C at a rate of 2°C and hold until the run is over.

To evaluate the performance of the tubes, spiked tubes were prepared by the direct injection technique (Riggin, 1984). A standard aromatic mixture was prepared in methanol solvent containing 35mg each of benzene, toluene, ethylbenzene, and p-, m-, and o-xylene per liter of solution. One μl of this solution was injected midway into a clean Tenax tube. Additional methanol was transferred from the 1μl syringe to the tube to ensure total transfer. The tube was connected to the desorption unit and purged with nitrogen at 30 ml/min at room temperature to remove methanol. The jacket heater was then turned on and the tube contents backflushed onto the GC column.

The precision and reproducibility of the GC response and retention times for the compounds of interest were determined with this spiked Tenax tube procedure, with results as shown in Table A-1. The reproducibility is good, with GC responses varying by 8±2%, except for the p- and m-xylenes, which had a 14% variation due mainly to the incomplete resolution of these two compounds on the column.

Breakthrough tests for the aromatics were performed by means of this spiking procedure. Concentrations from 0.05ppbV to 30ppbV were used. After the injection of the standard mixture, nitrogen carrier gas was drawn through each Tenax tube at a flow rate of 0.25l/min for 20 minutes to simulate a sampling volume of 5.0 liters. For this series of tests, a backup tube was used in each evaluation. Since the theoretical volume for benzene at 38°C is 19 liters of sampling volume per gram of Tenax, the sampling volume for a tube containing 0.15g Tenax should be approximately 2.8 l.

Table A-1. Precision of Direct Thermal Desorption and GC Analysis for Selected Compounds*

Compound	Peak Area (10^6 Counts)	Retention Time (minutes)
1. Benzene	3.55±0.30(8%)	5.06±0.22(4%)
2. Toluene	2.88±0.17(6%)	9.88±0.22(2%)
3. Ethyl Benzene	2.36±0.24(10%)	15.37±0.14(1%)
4. p-Xylene	1.54±0.21(14%)†	15.45±0.13(1%)
5. m-Xylene		16.94±0.11(1%)
6. o-Xylene	2.93±0.16(6%)	18.35±0.11(1%)

* Based on analysis of four separate Tenax cartridges each spiked with 35ng each of six aromatic compounds of interest.

† p- and m-Xylene not completely resolved from each other by this GC column.

A-3.0 Interlaboratory Reference Mixture Comparisons

Synthetic mixtures in canisters were made available by ASRL, RTP, NC, for cross-checking the Tenax tube-GC methods against known blends. Three canisters were analyzed. Two were mixtures of benzene, toluene, and the xylenes. These were sampled by passing approximately two liters of the mixtures or 0.5 l of the benzene standard at about 50 ml/min through Tenax tubes. The tubes were analyzed as described above. The results are given in Table A-2. For three tube replicates the standard deviations were approximately 20% for mixture I and 15% for mixture II. For five tubes the standard deviation for the benzene standard was 12%. The ratio of average detected concentrations to the expected (prepared) concentrations for the various compounds in the mixtures varied over 87-124%; for benzene alone it was 98%.

In connection with the analyses for the first sampling episode on July 9-11, 1985, EPA Mixture No.II, which had been run at GGC, was sent to ASRL, RTP, NC, for check runs. The results are shown in Table A-3. GGC values for toluene and the xylenes are slightly higher than the nominal values. The ASRL vlues for xylene are lower than nominal, suggesting the possibility of loss in xylenes as the canister was stored and depleted. For the second episode on September 4-5, 1985, EPA Mixture No. I (not the same as the one listed in Table A-2) was used in the same way, with the results shown in Table A-4. Here all values for the two labs are in good agreement except those for p-xylene, where the GGC value is about 25% higher than that of ASRL.

A-4.0 Results with Co-located Samplers

Interlaboratory comparisons of field samples were made in two ways:

1. Canisters and Tenax traps were co-located during sampling. The Tenax traps were analyzed by GGC, the canisters by ASRL and in some cases also by GGC, as in (2) below. This compares combined sampling and analytical methods by the two procedures. This was carried out during the two 1985 studies only. Results are given in Tables A-5 and A-6.

2. Aliquots from canister samples were transferred to Tenax traps and analyzed by GGC. The canisters were then sent to ASRL and analyzed there. This served to compare analytical methods as applied to air samples. This was carried out for all three episodes, two in 1985 and one in 1986. Results are given in Tables A-7 and A-8 for 1985, and A-9 through A-11 for 1986 runs.

Co-located Tenax traps served for intralaboratory estimation of the precision of sampling plus analysis with the traps. This was carried out for all study episodes. These are reported along with the rest of the data for the Tenax analyses in Section 5.

Table A-2. Analysis of EPA Reference Mixtures I and II and Benzene SRM*

*EPA Mix I

Component	Trap A**	Trap B	Trap I	Trap J	GGC Ave. Conc.	ASRL Ave. Conc.	% Difference
Benzene	24.39	18.25	17.48	24.30	20.01±3.74(19%)	16.20	+24%
Toluene	26.58	41.00	35.05	52.78	42.94±9.02(21%)	40.50	+ 6%
Ethylbenzene	—	—	—	—	—	—	—
p-xylene	8.71	19.39	10.86	22.88	53.60±13.83(26%)	61.90	-13%
m-xylene	33.60	29.22	44.84	---			
o-xylene	4.81	27.86	25.04	36.88	29.93±6.18(21%)	29.70	+ 1%

** Bad data, due to poor practice

EPA Mix II

Component	Trap C	Trap E	Trap I	GGC Ave. Conc.	ASRL Ave. Conc.	% Difference
benzene	54.50	71.77	63.07	63.11±8.64(14%)	61.8	+ 2%
toluene	43.82	54.27	45.63	47.91±5.58(12%)	42.7	+12%
ethylbenzene	—	—	—	—	—	—
p-xylene	—	—	—	—	—	—
m-xylene	4.54	5.88	4.79	5.07±0.71(14%)	4.6	+10%
o-xylene	5.48	7.46	5.91	6.28±1.04(17%)	5.4	+16%

Benzene

Component	Trap F	Trap G	Trap H	Trap K	Trap L	GGC Ave. Conc.	ASRL Ave. Conc.	% Difference
benzene	315.74	359.93	221.35	395.72	421.71	373.28±45.96(12%)	380.	- 2%

* Two Liter samples of Mixtures I and II and 0.5 liters of Benzene SRM were taken on the Tenax cartridges.

TABLE A-3. COMPARISON OF GGC AND EPA RESULTS FOR EPA MIX II, ppbC

Compound	GGC	EPA
Benzene	63.07	67.0
Toluene	45.63	40.2
m-Xylene	4.79	2.9
o-Xylene	5.91	3.3

TABLE A-4. COMPARISON OF GGC AND EPA RESULTS FOR EPA MIX I, ppbC

Compound	GGC	EPA
Benzene	56.3	53.0
Toluene	105.1	101.0
Ethylbenzene	47.3	49.9
p-Xylene	60.0	48.5
o-Xylene	68.6	65.2

Table A-5. Replicate analyses of samples from The Taft site, first episode (ppbV)

Trap#	Benzene	Toluene	Ethyl Benzene	m+p-Xylenes	o-Xylene	Remarks	
21	0.41	0.53	ND	0.33	ND	Trap	Co-located
22	0.36	0.43	***	***	***		
R	4.31	2.55	10.29	2.12	2.36	Canister	
S	2.97	1.83	10.68	1.57	2.33		
28	0.43	0.75	ND	0.28	0.09	Trap	Co-located
29	0.51	0.90	0.22	0.83	0.26		
N	5.53	5.36	16.58	4.65	1.94	Canister	
O	4.34	3.77	0.73	3.52	1.29		
15	3.85	13.74	7.25	19.43	10.04	Trap	Co-located
16	5.34	20.09	6.29	21.59	10.11		
P	5.72	16.60	2.92	16.57	4.75	Canister	
Q	11.10	22.43	8.48	23.84	13.16		
11	5.42	19.10	4.27	13.79	4.79	Trap	Co-located
12	6.07	23.56	9.04	25.04	11.39		
T	8.58	30.97	14.62	36.45	15.72	Canister	
U	4.71	22.44	10.22	29.34	14.87		
T	8.58	30.97	14.62	36.45	15.72	Same Canister	Analytical Replicates*
20	25.20	41.01	88.69	86.55	31.59		
13	3.53	28.80	6.45	20.75	7.39	Traps	Co-located
14	3.16	19.19	6.31	19.03	7.63		
17	1.86	5.71	0.79	3.14	1.57	Traps	Co-located
18	1.51	4.17	0.86	2.62	0.90		

Trap #20 was the duplicate of canister #10, but the sample volume was only 10% of that for trap #T.

Table A-6. Replicate Analyses of samples from the Taft site, second episode

Replicates (ppb V)

Trap#	Benzene	Toluene	Ethyl-Benzene	p-Xylene	m-Xylene	o-Xylene	Remarks	
42	434.35	48.96	23.30		4.96	3.75	Trap	Co-located
50	8.79	3.19	3.40	0.89	2.86	1.06	Canister	
51	5.94	1.89	7.39	ND	2.28	0.84		
46	2.24	1.23	5.84		0.74	1.39	Canisters	Co-located
47	3.79	1.58	6.20		1.77	1.36		
48	5.83	7.31	5.69	1.73	3.53	2.14	Canisters	Co-located
49	4.70	7.37	9.09	1.65	3.57	1.49		
52	5.06	2.88	12.29	ND	1.17	0.76	Analytical Replicates (Same Canister)	
53	3.14	1.36	6.08	ND	1.60	0.79		

TABLE A-7

Comparison Results Between Global Geochemistry
and the Gas Kinetics and Photochemistry Branch
for the July 15, 1985 Study (ppbC)

Sample***	Benzene		Toluene		Ethylbenzene		p+m-Xylene		O-Xylene	
	GGC	ASRL	GGC	ASRL	GGC	ASRL	GGC	ASRL	GGC	ASRL
2	33.2	33.7	37.5	50.8	132.6*	14.4	37.2*	45.5	15.5	18.0
4	26.0	17.8	26.4	38.4	5.8	12.6	28.2*	39.9	10.3	18.4
6	34.3	17.3	116.2	167.2	23.4	75.9	132.6*	198.6	38.0	68.8
9	25.9	23.8	17.9	26.1	82.3*	13.4	17.0**	29.4	18.9**	21.1
11	17.8	9.2	12.8	19.3	85.4	14.1	12.6	26.7	18.6	11.4
12	28.3	18.7	157.1	209.9	81.8**	96.9	234.7*	244.7	119.0*	90.3

* Unresolved peaks

** Estimation due to poor peak shapes or inappropriate integration

*** "Can" Nos. in Table 32 and Figures 4-8, main text

TABLE A-8. Comparison Results Between Global Geochemistry and EPA for the September 5, 1985 Samples, ppbC

Sample *	Benzene GGC	Benzene ASRL	Toluene GGC	Toluene ASRL	Ethylbenzene GGC	Ethylbenzene ASRL	m + p-Xylene GGC	m + p-Xylene ASRL	o-Xylene GGC	o-Xylene ASRL
10	28.2	23.8	51.6	7.0	72.7	3.4	41.8	593.0	11.9	8.7
3	22.7	51.9	11.1	11.6	49.6	9.6	14.2	14.5	10.9	9.3
ARB-9	35.0	103.0	51.2	51.2	45.5	15.0	42.1	46.6	17.1	20.0
2	30.4	12.2	20.2	9.9	98.3	7.5	9.4	20.0	6.1	10.4
2 (replicate)	18.8	12.2	9.5	9.9	48.6	7.5	12.8	20.0	6.3	10.4
4	13.4	5.4	8.6	8.5	46.7	4.7	5.9	9.4	11.0	10.2
ARB-6	--	37.9	--	10.0	--	7.7	--	20.6	--	9.9
6	52.7	17.0	22.3	16.4	27.2	11.4	30.0	28.3	8.5	10.1

* Canister numbers in Figures 9-12, main text.

** Samples sent out for GC/MS analysis

Table A-9. Comparison Between GGC and EPA Results in ppbC for the Canister Samples Collected During Test 1 of the May 20 to 23, 1986 Study

	UPWIND		ONSITE				DOWNIND			
	Can 1		Can 2		Can 3		Can 4		Can 5	
Compound	GGC	EPA	GGC	EPA	GGC	EPA	GGC	EPA	GGC	EPA
Benzene	tr.	3.4	79.3	26.7	5.1	7.9	27.1	6.5	4.6	1.6
Toluene	3.0	2.9	36.1	180.6	34.0	28.1	74.7	58.9	5.0	4.8
Ethylbenzene	2.7	1.5	20.7	53.6	15.4	17.8	5.2	0.9	nd	0.7
m-+p-Xylene	nd	2.3	63.8	151.0	49.0	49.7	141.7	126.9	nd	3.7
o-Xylene	nd	5.6	15.5	7.3	33.3	16.7	142.0	115.6	4.8	6.7
Sum C_6 to C_8 Aromatics	--	15.7	--	419.2	--	120.2	--	308.8	--	17.5
TOTAL NMOC	--	487.3	--	9545.4	--	1799.1	--	1287.1	--	290.3
C_6-C_8 Aromatic Fraction	--	0.032	--	0.044	--	0.067	--	0.240	--	0.060

Table A-10. Comparison Between GGC and EPA Results in ppbC for the Canister Samples Collected During Test 2 of the May 20 to 23, 1986 Study

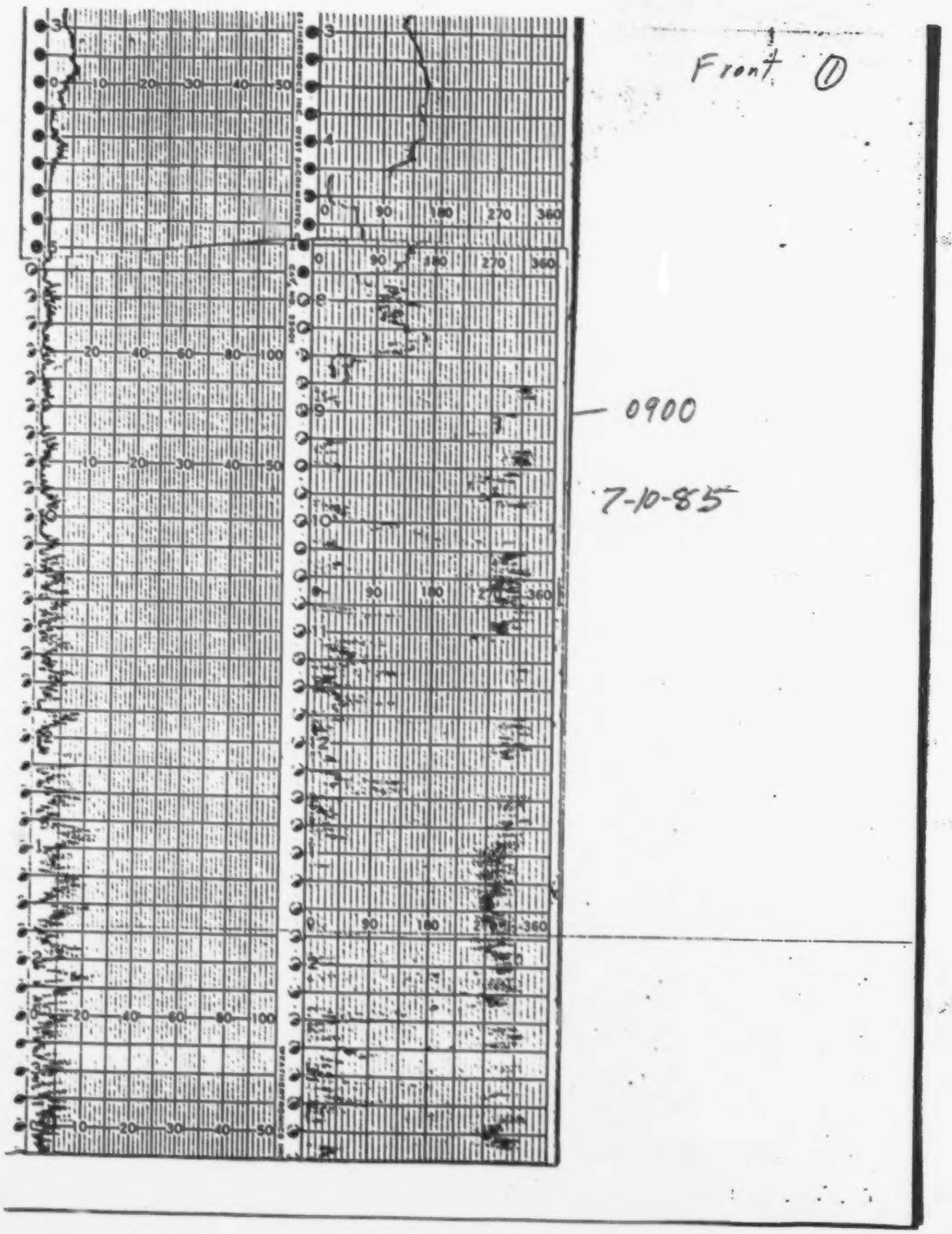
	UPWIND		ONSITE				DOWNIND			
	Can 6		Can 7		Can 8		Can 9		Can 10	
Compound	GGC	EPA	GGC	EPA	GGC	EPA	GGC	EPA	GGC	EPA
Benzene	5.2	3.5	2.1	2.9	6.3	3.4	n.d.	1.9	4.5	2.4
Toluene	19.2	16.7	6.6	9.7	14.2	12.6	2.1	2.0	2.8	2.1
Ethylbenzene	21.4	11.6	11.0	5.9	11.8	8.3	3.4	2.0	n.d.	0.6
m-+p-Xylene	29.1	27.3	6.3	9.4	18.1	15.6	2.7	2.1	n.d.	2.5
o-Xylene	12.8	12.4	4.7	8.0	16.2	10.4	n.d.	3.5	n.d.	n.d.
Sum C_6-C_8 Aromatics	--	71.5	--	35.9	--	50.3	--	11.5	--	7.6
Total NMOC	--	1238.0	--	699.2	--	820.9	--	234.6	--	226.1
C_6-C_8 Aromatic Fraction	--	0.058	--	0.051	--	0.062	--	0.049	--	0.028

Table A-11. Comparison Between GGC and EPA Results in ppbC for the Canister Samples Collected During Test 3 of the May 20 to 23, 1986 Study

Compound	UPWIND Can 11 GGC	UPWIND Can 11 EPA	ONSITE Can 12 GGC	ONSITE Can 12 EPA	ONSITE Can 13 GGC	ONSITE Can 13 EPA	DOWNIND Can 15 GGC	DOWNIND Can 15 EPA
Benzene	2.9	3.0	14.4	6.7	12.6	4.5	6.8	4.2
Toluene	5.8	5.0	22.9	12.8	28.5	10.9	3.9	6.1
Ethylbenzene	n.d.	1.4	26.4	4.5	36.7	5.9	n.d.	2.0
m-+p-Xylene	n.d.	1.9	21.3	14.1	21.2	14.7	1.7	3.8
o-Xylene	n.d.	1.4	10.2	6.5	6.7	6.9	4.5	5.3
Sum C_6-C_8 Aromatics	--	12.7	--	44.6	--	42.9	--	21.4
Total NMOC	--	147.5	--	1085.8	--	680.7	--	442.2
C_6-C_8 Aromatic Fraction	--	0.086	--	0.041	--	0.063	--	0.048

A-5.0 FIELD METEOROLOGICAL DATA CHARTS

Direct copies of charts showing wind speed (knots) or wind run (miles), wind direction (degrees from north), temperature (degrees F), and relative humidity are given in the next eight pages for the two 1985 sampling episodes. During the 1986 episode, an integrating anemometer was used; the tabular data from that instrument are included on the polar sampling plots in Section 5. It gave wind direction and velocity every five minutes and integrated averages of the same parameters, along with the standard deviation of the wind direction, for every 30 minute period.



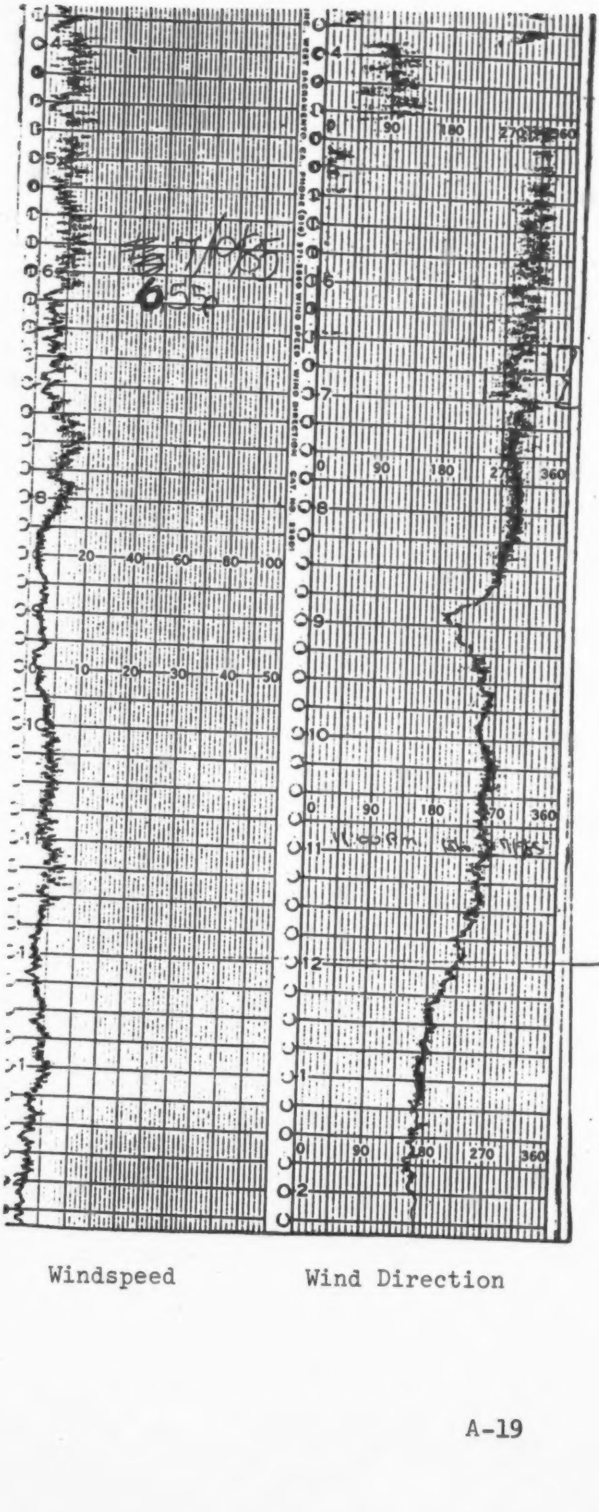
Front ①

0900

7-10-85

Windspeed Wind Direction

2

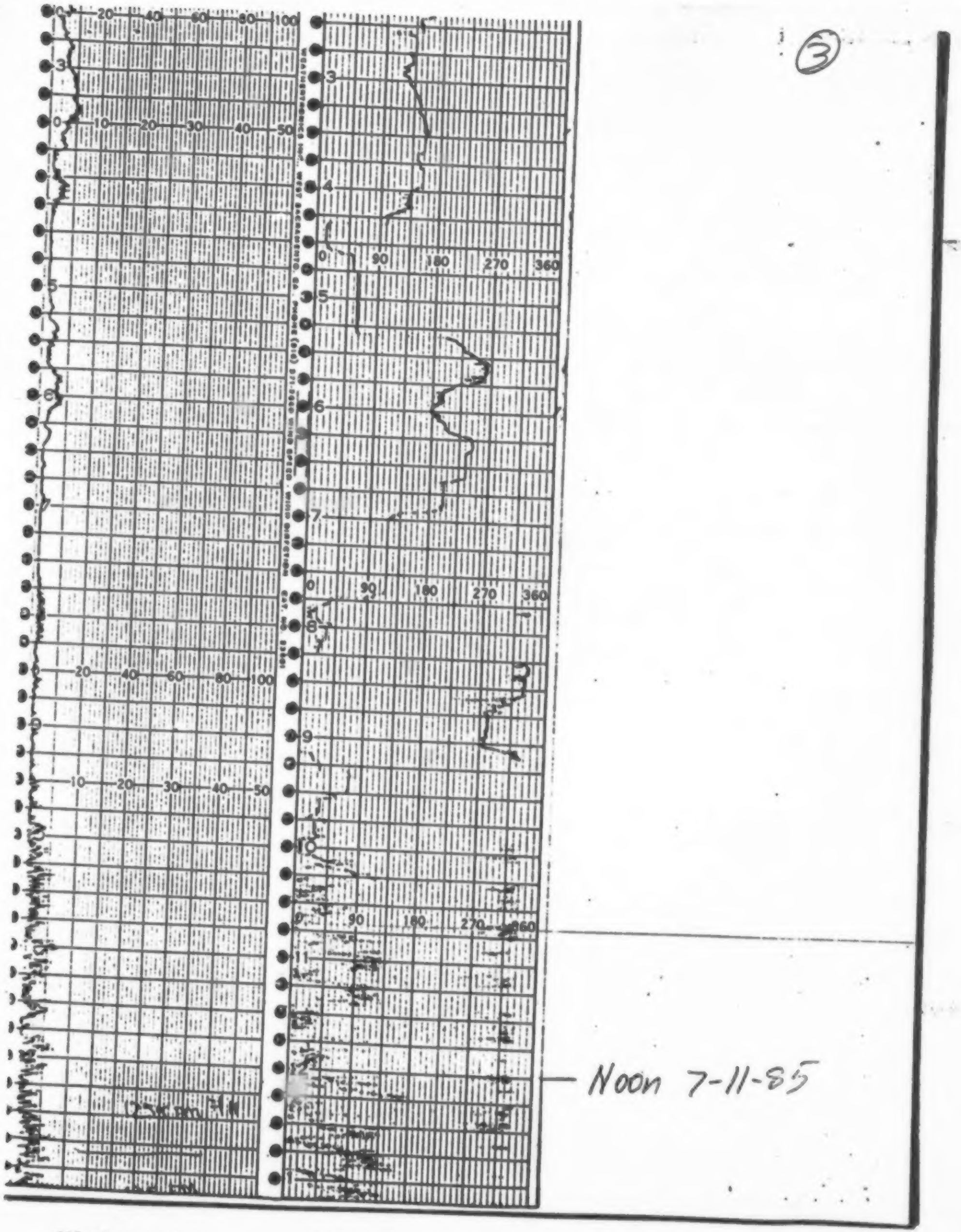


6:55pm

7-10-85
Midnight
7-11-85

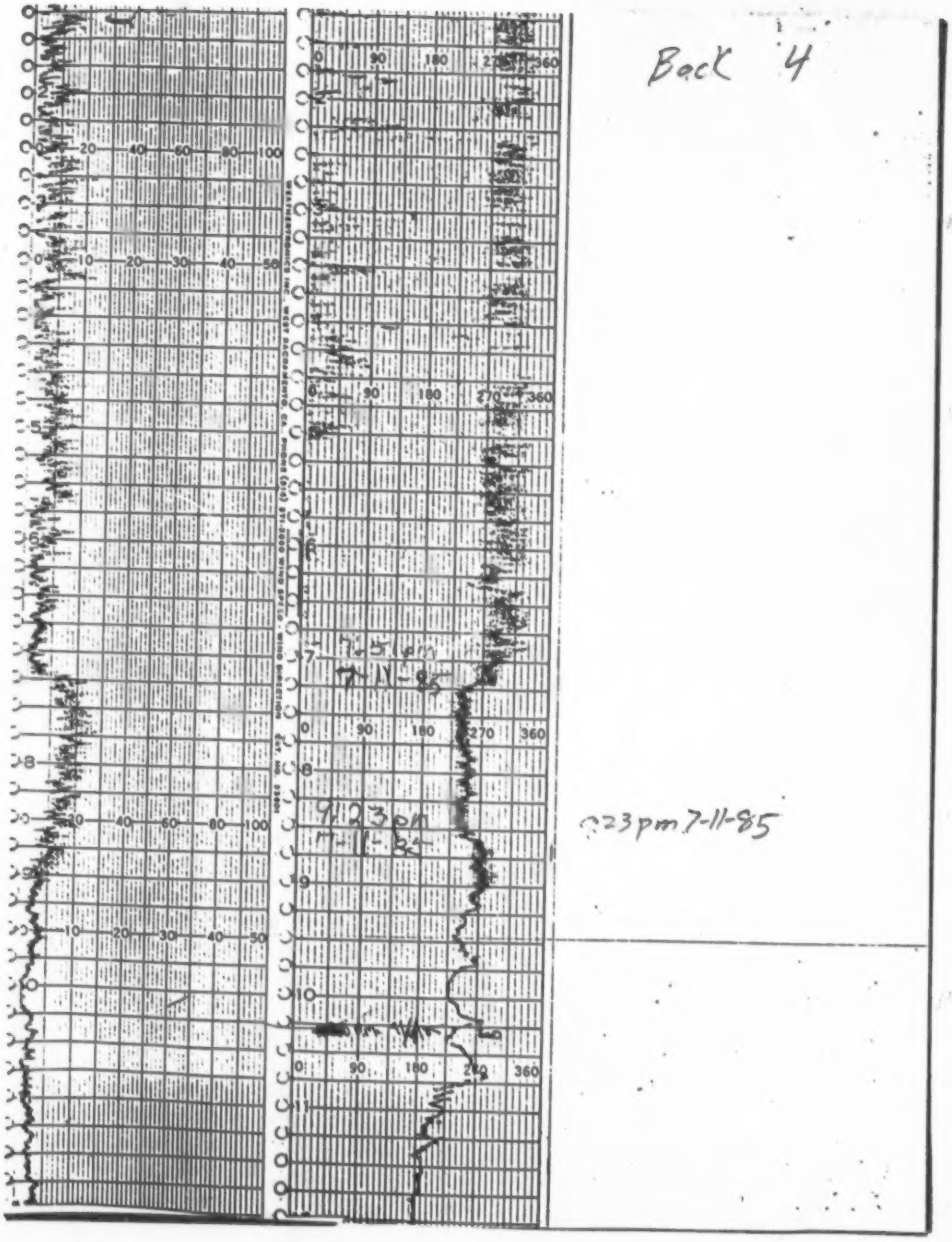
Windspeed Wind Direction

③



Noon 7-11-85

Windspeed Wind Direction



Back 4

7:51pm 7-11-85

9:23pm 7-11-85

9:23pm 7-11-85

Windspeed

Wind Direction

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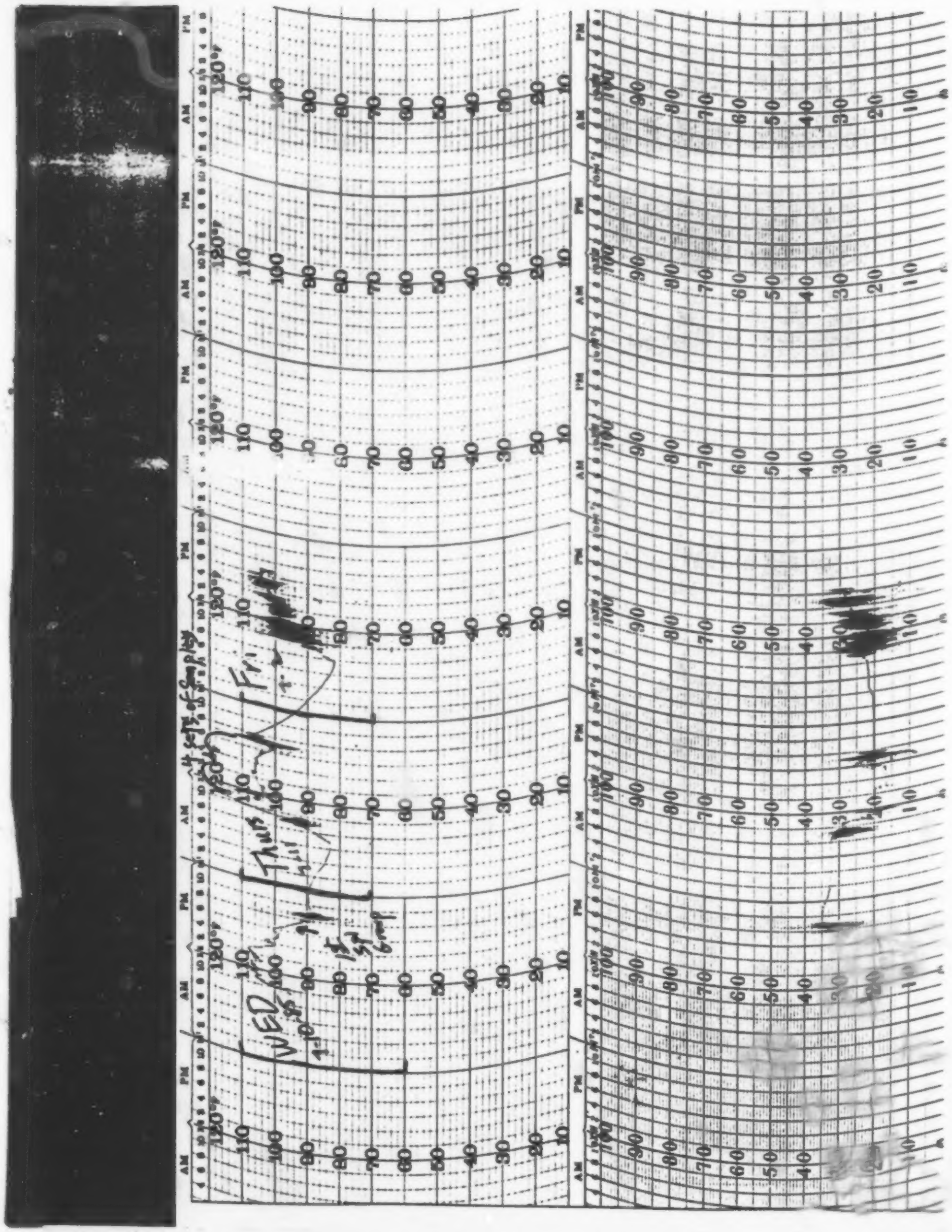
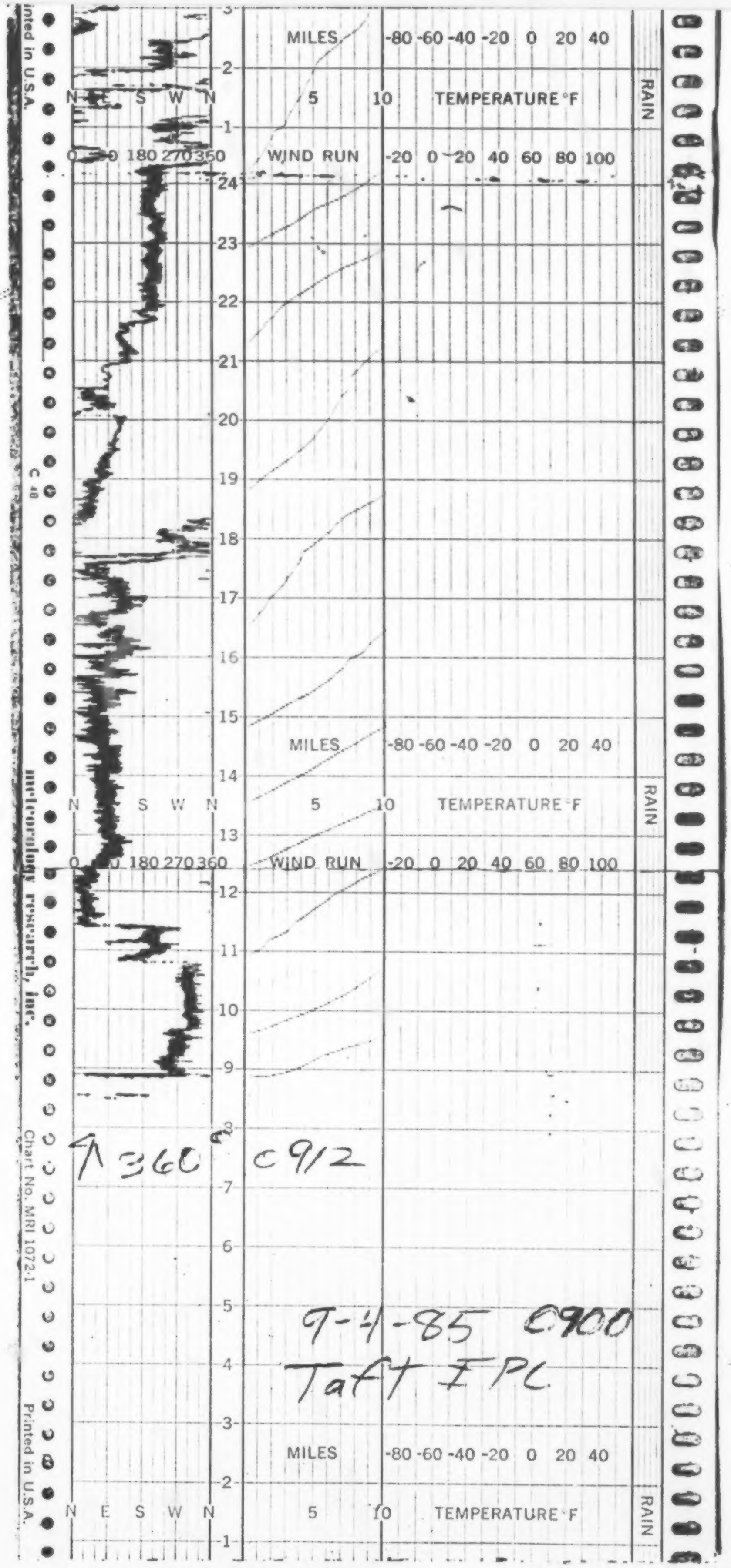


Temperature, °F

Relative Humidity



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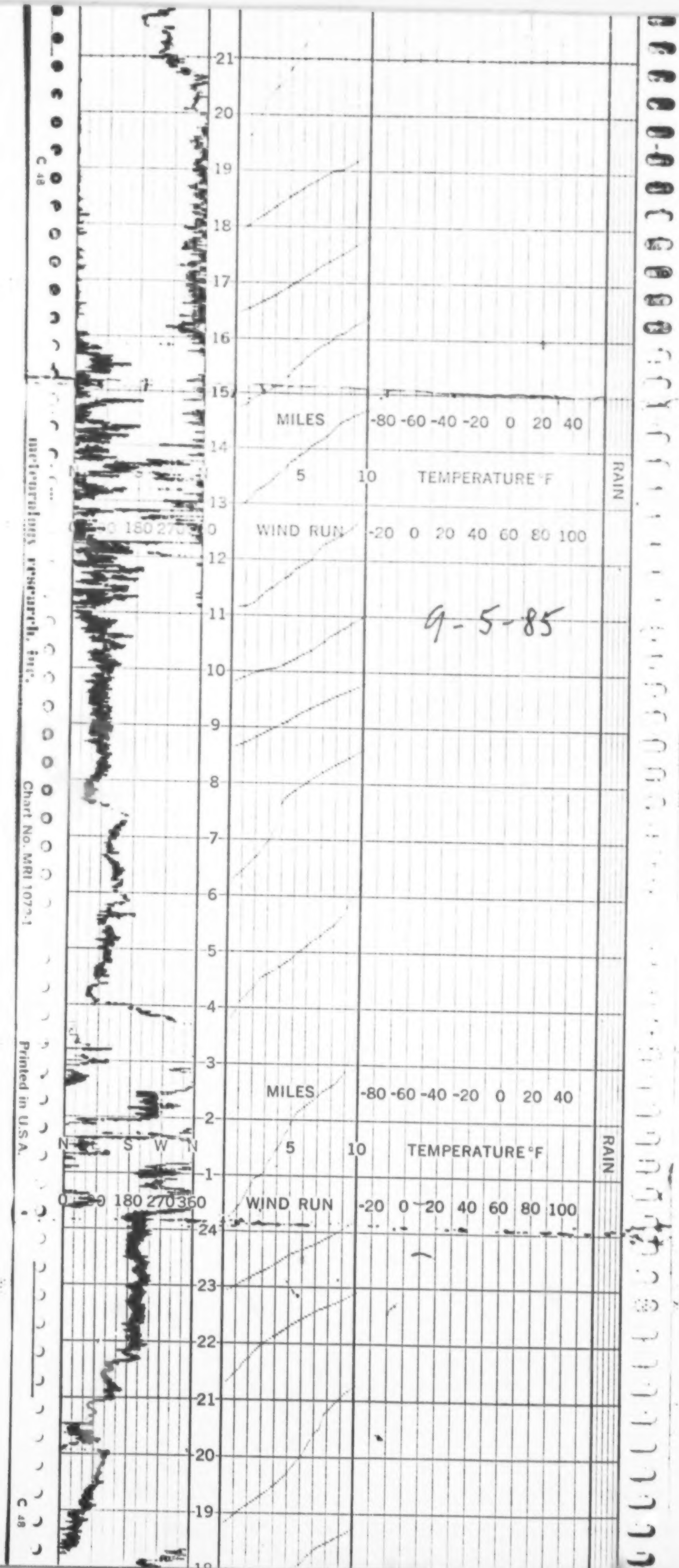
9-4-85 0900
Taft EPC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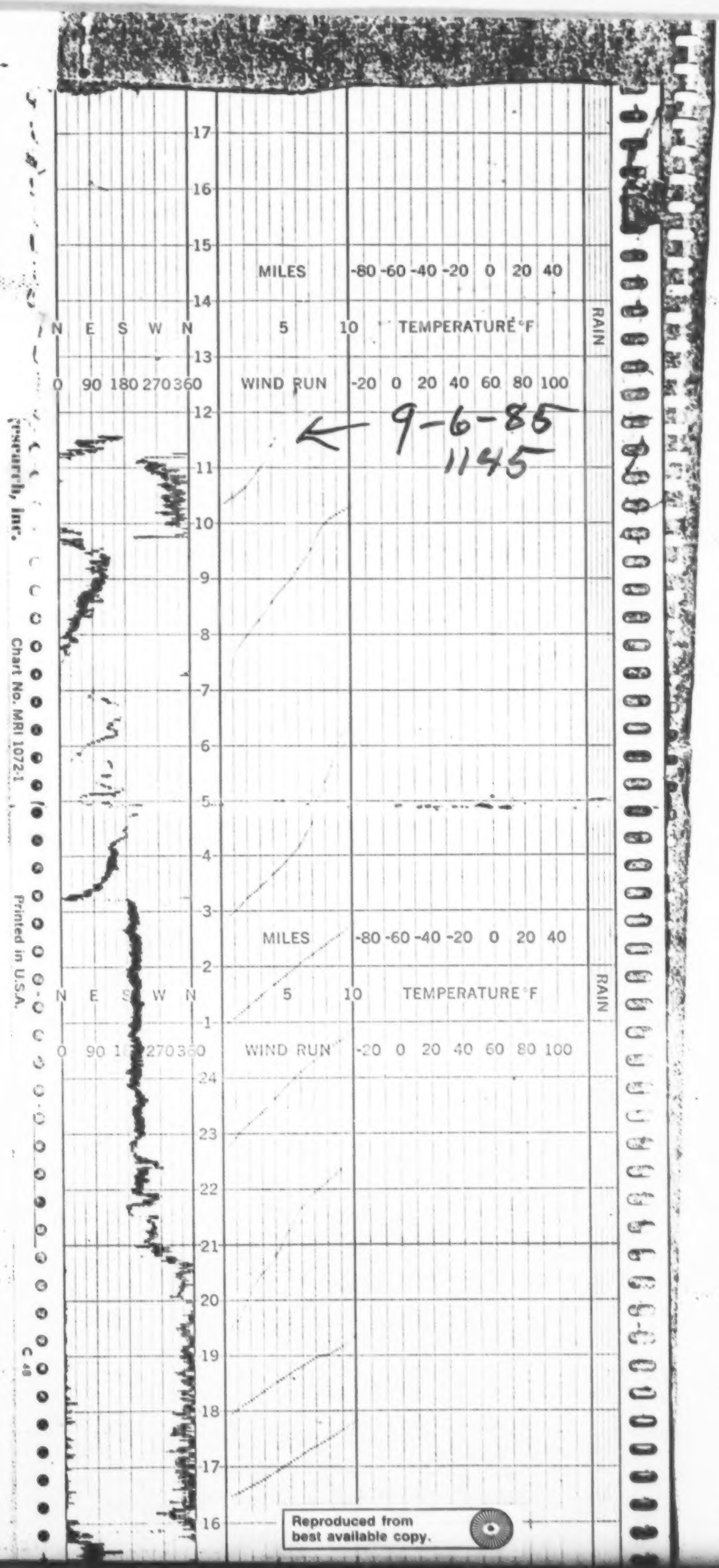
20
19
MILES
-80 -60 -40 -20 0 20 40
5
10
TEMPERATURE °F
RAIN
N E S W N
0 90 180 270 360
WIND RUN
-20 0 20 40 60 80 100
C 48
meteorology research, inc.
Chart No. MRI 1072-1
Printed in U.S.A.

9-5-85



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1145

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A-6.0 CAPILLARY GC-FID LISTINGS FOR CANISTER ANALYSES

Thirteen canister samples from the 1985 sampling episodes were analyzed by ASRL, RTP, NC, using capillary GC with FID detection. In the 1986 sampling episode, fifteen more canisters were used for sampling, five at a time, as shown in Section 5. These were also analyzed by capillary GC with FID. Over 200 compounds were observed in most of these, and many were identified. Six selected examples of actual ASRL chromatograms of canister contents from the 1986 episode are reproduced in Figures A-5, A-6 and A-7, showing the complexity of the mixtures.

The listings that follow Figure A-7 show the retention times, the concentrations in ppbC, and identifications (where available) for all the ARSL chromatograms. The identities of the canister samples for the 1985 episodes in terms consistent with those in the main body of the text (Tables 33 and 34) and in this Appendix (Tables A-7 and A-8) are as follows:

ASRL Listing	Table Identification
GGC 2	2
GGC 4	4
GGC 6	6
GGC 7	7
GGC 11	11
GGC 12	12
GGCN 1	10
GGCN 2	3
GGCN 3	ARB-9
GGCN 4	2
GGCN 5	4
GGCN 6	ARB-6
GGCN 7	6

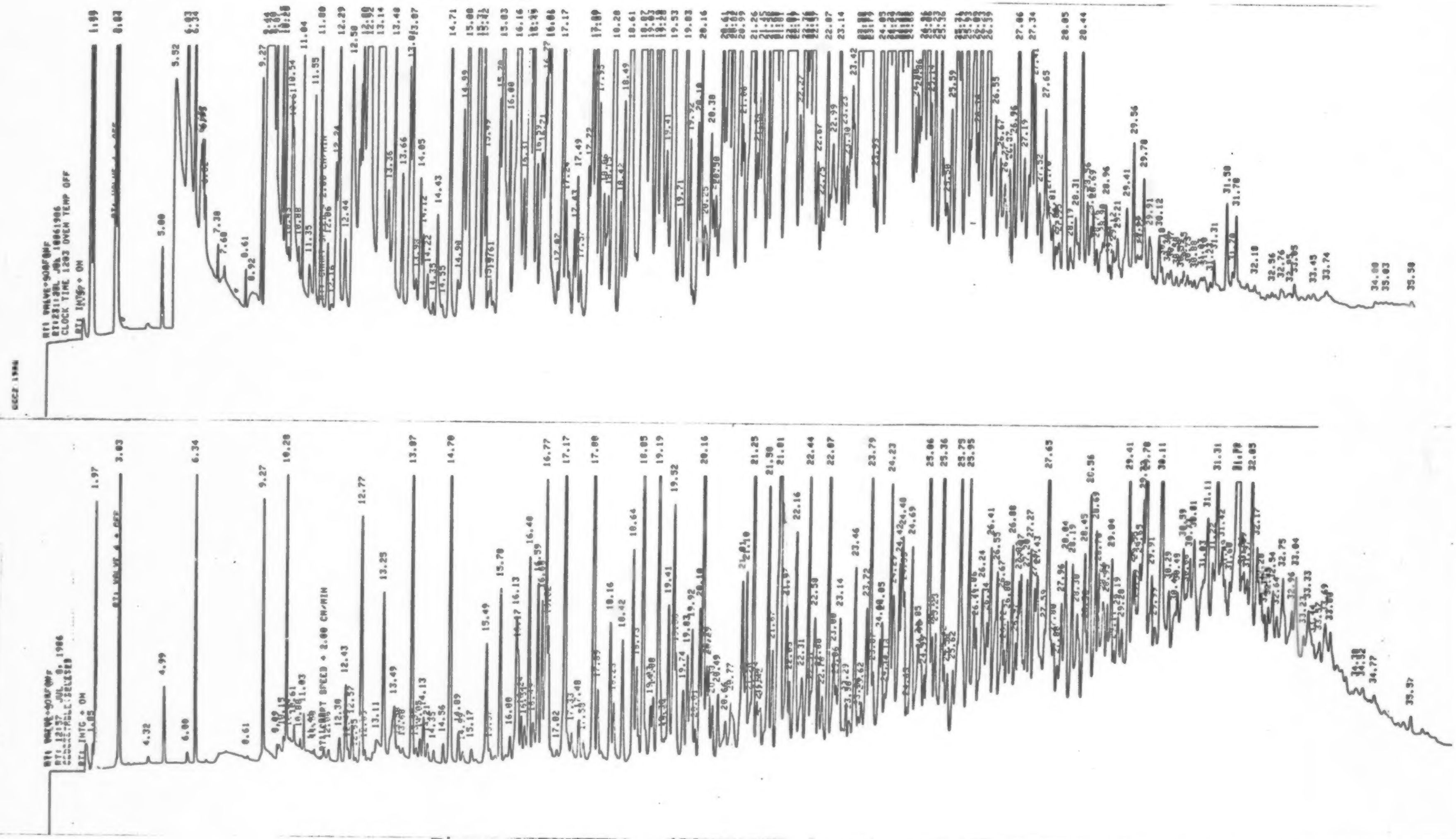

Figure A-5. ASRL capillary gas chromatograms of canister samples 2 and 3.

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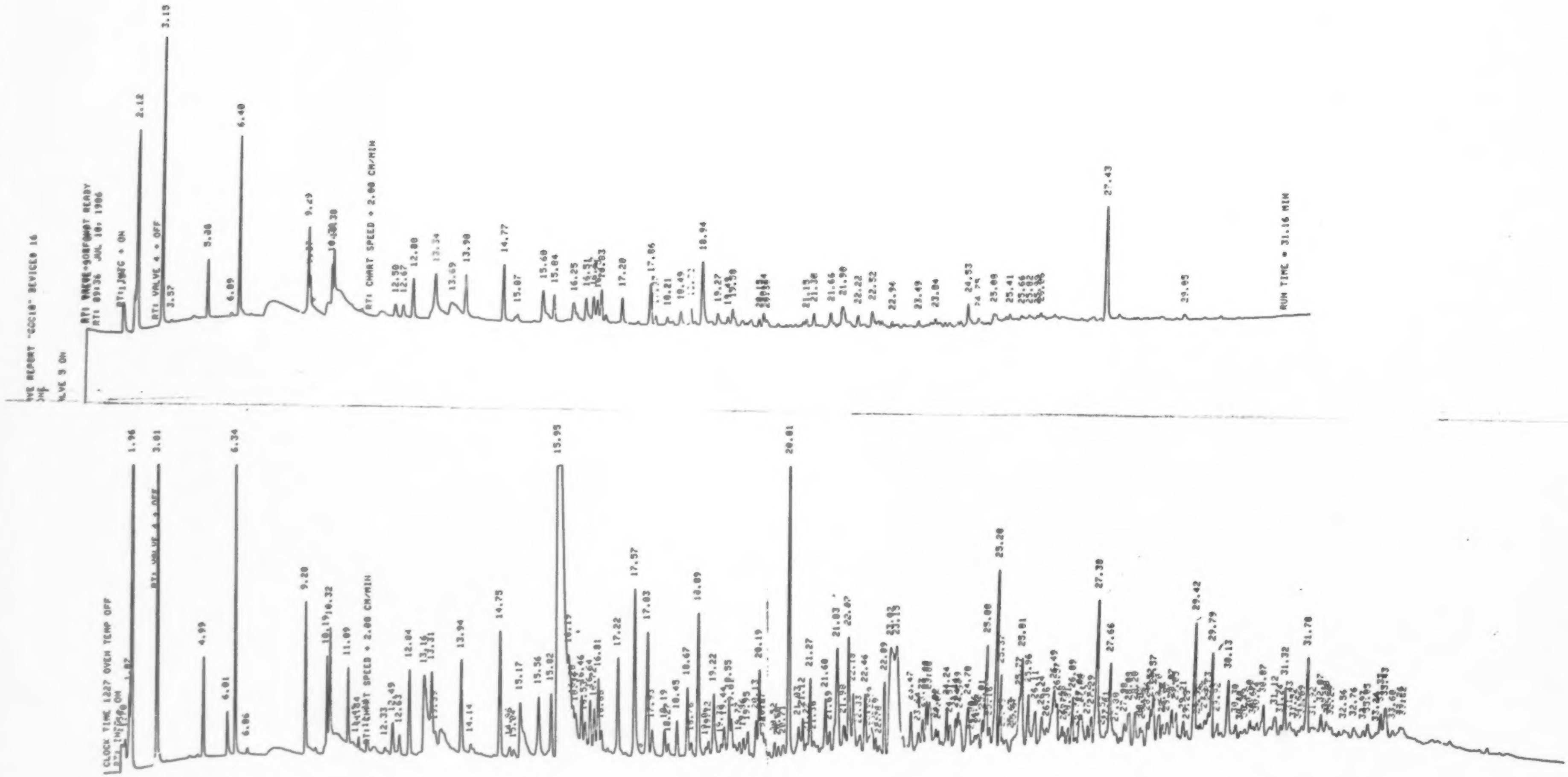

Figure A-6. ASRL capillary gas chromatograms of canister samples 11 and 12.

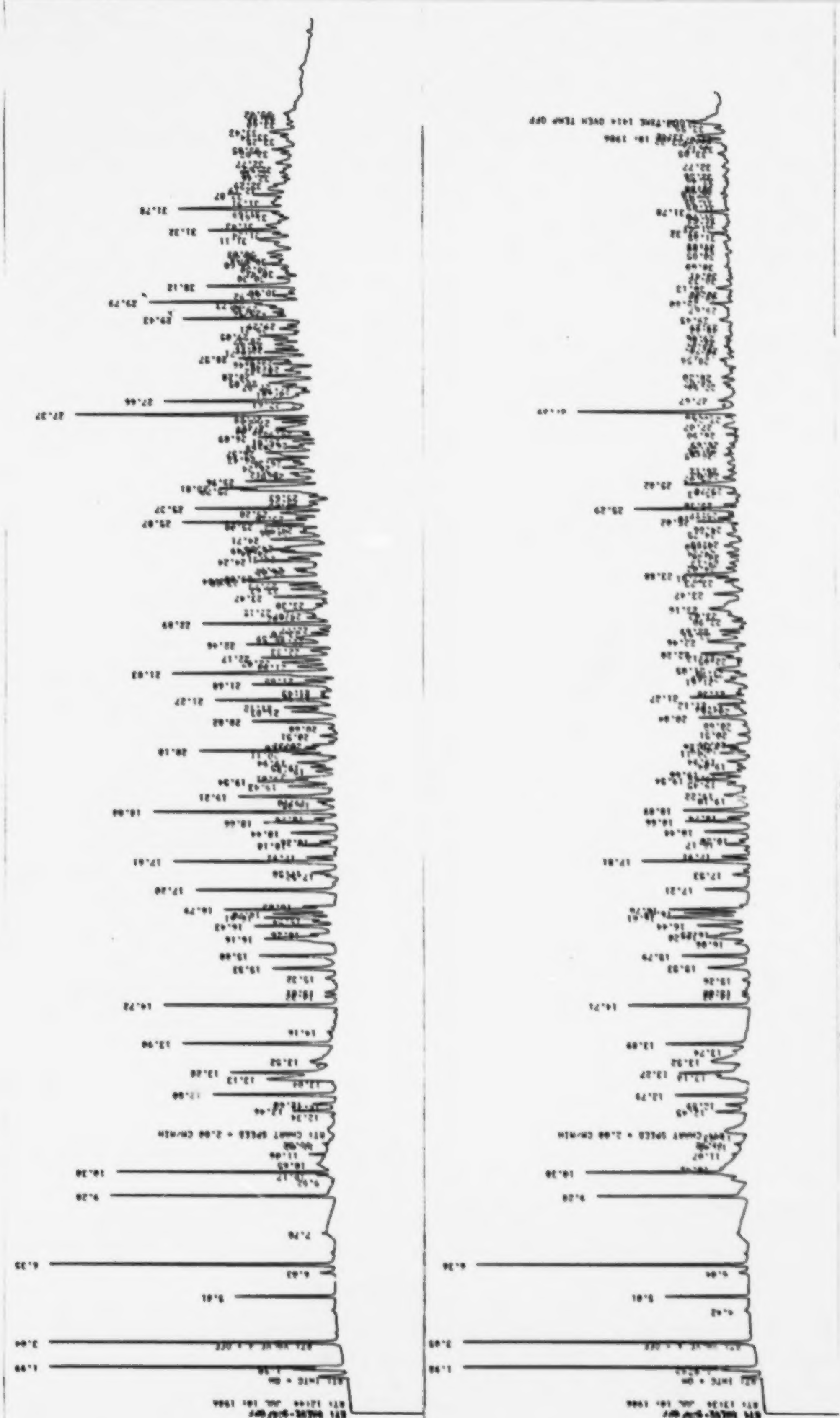

Figure A-7. ASRL capillary gas chromatograms of canister samples 13 and 15.

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Page No.     1
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                    Peak Identification Report  GGC2
Retention Concentration          TOTAL NMOC = 5.609 pp
  Time          PPBC  CAL# Compound Name

   1.749        0.46     0 Uncalibrated
   1.871        4.64   101 ETHANE
   1.977       46.50     0 Uncalibrated
   2.973        7.69   104 PROPENE
   3.074      101.08   105 PROPANE
   5.077      295.36   110 ISOBUTANE
   6.104       36.75   113 2-METHYL PROPYLENE
   6.317        0.24   114 BUTENE 1
   6.445      974.46   115 n-BUTANE
   6.932       24.46   116 t-2-BUTENE
   7.264        0.34   341 C4 OLEFIN
   7.494       14.56   117 c-2-BUTENE
   7.807        0.20     0 Uncalibrated
   8.735        5.76   118 C4 OLEFIN
   9.396      390.51   119 ISOPENTANE
   9.759       19.23   393 C5 OLEFIN
  10.002       10.96   121 1-PENTENE
  10.115        3.37   394 C5 OLEFIN
  10.274       13.28   123 2-METHYL-1-BUTENE
  10.410      143.48   124 n-PENTANE
  10.563        0.25   125 ISOPRENE
  10.681        0.71     0 Uncalibrated
  10.738        6.68   126 t-2-PENTENE
  10.870        1.11   413 C5 OLEFIN
  11.000        3.55   127 C5 OLEFIN
  11.159       10.06   129 c-2-PENTENE
  11.522        9.31   132 C6 PARAFFIN
  12.035        0.80   134 C6 OLEFIN
  12.240        1.12   135 C6 OLEFIN
  12.478        1.02   136 C6 PARAFFIN
  12.616        9.04   138 CYCLOPENTANE
  12.752        2.13   139 2,3-DIMETHYLBUTANE
  12.947       12.16   141 2-METHYLPENTANE
  13.127       25.40   407 C6 PARAFFIN
  13.303        6.36   369 C6 PARAFFIN
  13.350        9.35   144 C6 OLEFIN
  13.426       15.20   145 3-METHYLPENTANE
  13.664        1.72   344 C6 OLEFIN
  13.839        0.22   147 C6 OLEFIN
  14.049       10.70   148 n-HEXANE
  14.225        0.38   150 C7 OLEFIN
  14.302        0.78   151 C7 OLEFIN
  14.397        0.20   152 C7 OLEFIN
  14.733        0.21   155 C7 OLEFIN
  14.886       12.24   156 METHYLCYCLOPENTANE
  15.073        0.98   157 2,4-DIMETHYLPENTANE
  15.160       11.57   158 C7 PARAFFIN
  15.293        1.52   159 C7 OLEFIN
  15.513        0.75   160 C7 OLEFIN
  15.672       33.71   162 BENZENE
  15.795        0.53   387 C7 OLEFIN
```

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Page No.     2
08/20/85
                    Peak Identification Report
Retention Concentration
  Time                CAL# Compound Name

  15.887        0.31   163 3,3-DIMETHYLPENTANE
  15.965      121.82   164 CYCLOHEXANE
  16.313        2.13   166 2-METHYLHEXANE
  16.351        5.05   167 2,3-DIMETHYLPENTANE
  16.587        7.28   170 3-METHYLHEXANE
  16.666        1.31   347 C7 PARAFFIN
  16.774        2.45   171 C7 PARAFFIN
  16.861        2.10   365 C7 PARAFFIN
  16.948        6.44   172 C7 PARAFFIN
  17.007        2.62   173 2,2,4-TRIMETHYLPENTANE
  17.108        6.91   348 C7 OLEFIN
  17.350        6.08   175 n-HEPTANE
  17.652       19.61   177 C8 OLEFIN
  17.976        6.24   179 METHYLCYCLOHEXANE
  18.052        3.85   366 C8 PARAFFIN
  18.335        1.64   180 C8 PARAFFIN
  18.407        1.42   181 C8 PARAFFIN
  18.595        1.29   182 C8 PARAFFIN
  18.665        0.05   397 C8 PARAFFIN
  18.808        3.63   183 C8 PARAFFIN
  18.892        1.27   184 2,3,4-TRIMETHYLPENTANE
  19.021       50.78   185 TOLUENE
  19.077        3.64     0 Uncalibrated
  19.215        2.54   187 C8 PARAFFIN
  19.359        4.40   187 C8 PARAFFIN
  19.453        3.10   352 C8 PARAFFIN
  19.584        2.25   191 C8 PARAFFIN
  19.709        9.60   192 C8 PARAFFIN
  19.908        0.70   193 C8 PARAFFIN
  19.954        0.99     0 Uncalibrated
  1[illegible]99        1.15   194 C8 PARAFFIN
  20.097        2.09   195 C8 PARAFFIN
  20.277        2.40   197 C8 PARAFFIN
  20.330        3.03   198 n-OCTANE
  20.376        0.44   199 C9 PARAFFIN
  20.470        0.12   200 C9 PARAFFIN
  20.519        0.71   354 C9 OLEFIN
  20.663        0.31   201 C9 PARAFFIN
  20.722        0.69   389 C9 PARAFFIN
  20.830        0.76   202 C9 PARAFFIN
  20.950       23.12   203 C9 OLEFIN
  21.171        2.27   206 C9 PARAFFIN
  21.230        0.23   207 C9 PARAFFIN
  21.278        1.40   208 C9 PARAFFIN
  21.427        4.17   210 C9 PARAFFIN
  21.591        0.65   212 C9 PARAFFIN
  21.749       14.41   213 ETHYLBENZENE
  21.842        1.94   214 C9 PARAFFIN
  21.978       45.52   215 m&p-XYLENE
  22.169       36.67   367 C9 PARAFFIN
  22.252        3.83   217 C9 PARAFFIN
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Retention Time	Concentration	CAL#	Compound Name
22.327	2.24	218	C9 PARAFFIN
22.477	1033.70	220	C9 OLEFIN
22.610	17.95	222	o-XYLENE
22.735	0.80	224	C9 PARAFFIN
22.857	0.35	226	C9 PARAFFIN
22.933	0.33	227	C9 PARAFFIN
22.992	1.33	0	Uncalibrated
23.042	5.21	228	n-NONANE
23.174	38.54	229	C10 PARAFFIN
23.447	12.24	232	C10 PARAFFIN
23.522	3.20	233	C10 PARAFFIN
23.635	1.74	234	C10 PARAFFIN
23.755	1.47	400	C10 PARAFFIN
23.948	156.74	238	C10 PARAFFIN
24.013	15.68	239	C10 OLEFIN
24.115	1.37	240	C10 OLEFIN
24.220	6.28	242	n-PROPYLBENZENE
24.323	0.63	243	C10 PARAFFIN
24.394	12.55	244	p-ETHYLTOLUENE
24.455	6.71	245	m-ETHYLTOLUENE
24.587	6.68	246	C9 AROMATIC
24.680	4.95	248	C10 PARAFFIN
24.826	18.56	249	o-ETHYLTOLUENE
25.074	4.06	251	C10 PARAFFIN
25.142	101.77	252	C10 OLEFIN
25.227	24.43	253	1,2,4-TRIMETHYLBENZENE
25.323	1.41	254	C9 AROMATIC
25.418	53.92	255	C10 PARAFFIN
25.531	8.48	256	n-DECANE
25.606	1.64	257	C9 AROMATIC
25.671	1.81	258	C9 AROMATIC
25.795	0.89	259	C9 AROMATIC
25.912	37.04	260	1,2,3-TRIMETHYLBENZENE
26.110	3.88	263	C11 PARAFFIN
26.224	17.17	264	C10 AROMATIC
26.390	12.07	265	C10 AROMATIC
26.559	48.63	267	C10 AROMATIC
26.679	5.02	401	C10 AROMATIC
26.722	6.38	268	C10 AROMATIC
26.842	2.02	270	C10 AROMATIC
26.891	1.11	271	C11 PARAFFIN
27.018	23.42	273	C11 PARAFFIN
27.141	9.01	373	C10 AROMATIC
27.202	32.78	275	C10 AROMATIC
27.375	5.04	277	C10 AROMATIC
27.465	10.43	278	C10 AROMATIC
27.500	9.26	355	C11 OLEFIN
27.603	1.78	279	C11 PARAFFIN
27.764	2.48	281	C10 AROMATIC
27.820	8.96	282	1,2-DIMETHYL-3-ETHYLBENZENE
27.878	6.11	403	C10 AROMATIC

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Retention Time	Concentration	CAL#	Compound Name
28.127	8.40	285	1,2,3,5-TETRAMETHYLBENZENE
28.207	12.87	286	C10 AROMATIC
28.370	4.14	288	C10 AROMATIC
28.465	5.07	374	C10 AROMATIC
28.517	2.30	357	C10 AROMATIC
28.667	19.94	291	C11 AROMATIC
28.740	5.62	292	C11 AROMATIC
28.823	5.34	0	Uncalibrated
28.872	10.34	293	C11 AROMATIC
28.934	7.34	294	C11 AROMATIC
29.037	270.12	380	C11 AROMATIC
29.129	14.13	296	C11 AROMATIC
29.212	8.27	297	C11 AROMATIC
29.357	4.46	299	C11 AROMATIC
29.430	7.39	377	C11 AROMATIC
29.590	440.68	300	C11 AROMATIC
29.701	15.63	301	C11 AROMATIC
29.849	4.66	302	C11 AROMATIC
29.898	3.99	303	C11 AROMATIC
29.950	17.99	304	C12 PARAFFIN
30.087	2.37	305	C11 AROMATIC
30.174	0.46	306	C11 AROMATIC
30.282	6.27	416	C11 AROMATIC
30.410	0.14	309	C11 AROMATIC
30.457	1.69	359	C11 AROMATIC
30.607	1.52	310	C11 AROMATIC
30.655	2.14	360	C11 AROMATIC
30.774	3.73	312	C12 PARAFFIN
30.912	4.25	314	C12 AROMATIC
30.993	3.43	361	C12 AROMATIC
31.084	2.50	315	C12 AROMATIC
31.211	2.20	316	C12 AROMATIC
31.307	8.84	318	C12 AROMATIC
31.437	3.11	319	C12 AROMATIC
31.507	1.93	320	C12 AROMATIC
31.590	5.35	0	Uncalibrated
31.680	2.03	322	C12 AROMATIC
31.797	0.59	362	C12 AROMATIC
31.927	13.80	323	C12 AROMATIC
32.102	1.25	325	C12 AROMATIC
32.299	10.91	327	C12 AROMATIC
32.483	2.32	404	C12 AROMATIC
32.635	1.13	330	C12 AROMATIC
32.711	0.73	331	C12 AROMATIC
32.919	10.75	0	Uncalibrated
32.971	3.58	333	C12 AROMATIC
33.068	4.84	334	C12 AROMATIC
33.158	6.45	336	C12 AROMATIC
33.237	2.84	0	Uncalibrated
33.298	4.63	410	C12 AROMATIC
33.402	5.41	381	C12 AROMATIC

```
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Retention Concentration
   Time                   CAL# Compound Name


   33.452            9.50  337 C12 AROMATIC
   33.517            1.73    0 Uncalibrated
   33.574            4.42    0 Uncalibrated
   33.756           10.22    0 Uncalibrated
   33.810           12.19  338 C12 AROMATIC
   33.924            1.56  339 C12 AROMATIC
   33.974            2.26    0 Uncalibrated
   34.020            6.25    0 Uncalibrated
   34.097            2.24    0 Uncalibrated
   34.296            4.52    0 Uncalibrated
   34.368            1.52  411 C12 AROMATIC
   34.436            0.54  390 C12 AROMATIC
   34.542            0.22  405 C12 AROMATIC
   34.715            0.23    0 Uncalibrated
   34.780            0.87    0 Uncalibrated
   34.848            3.56    0 Uncalibrated
   35.090            0.56    0 Uncalibrated
   35.373            0.24  378 C12 AROMATIC
   35.500            0.39    0 Uncalibrated
   35.645            0.86    0 Uncalibrated
   35.790            0.32  406 C:2 AROMATIC
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Retention Concentration
   Time                      CAL# Compound Name

     1.661          1.34      0 Uncalibrated
     1.699          0.09      0 Uncalibrated
     1.863          6.43    102 ETHYLENE
     1.972         46.87    101 ETHANE
     2.961          8.43    104 PROPENE
     3.075        105.22    105 PROPANE
     3.180          1.24      0 Uncalibrated
     3.517          0.20    107 PARAFFIN
     4.357          5.19    383 C3 PARAFFIN
     5.082        223.11    110 ISOBUTANE
     6.096         33.86    113 2-METHYL PROPYLENE
     6.271          0.71    114 BUTENE-1
     6.440        667.17    115 n-BUTANE
     6.920         15.90    116 t-2-BUTENE
     7.252          0.67    384 C4 PARAFFIN
     7.485          9.82    117 c-2-BUTENE
     7.771         31.89      0 Uncalibrated
     8.423          8.41      0 Uncalibrated
     8.722          3.58    118 C4 OLEFIN
     9.387        213.68    119 ISOPENTANE
     9.652         52.72    120 C5 OLEFIN
     9.992          5.84    121 1-PENTENE
    10.102          5.09    394 C5 OLEFIN
    10.264          9.88    123 2-METHYL-1-BUTENE
    10.401         80.40    124 n-PENTANE
    10.556          0.30    125 ISOPRENE
    10.618          2.99      0 Uncalibrated
    10.729          3.54    126 t-2-PENTENE
    10.927          0.42    413 C5 OLEFIN
    10.990          1.67    127 C5 OLEFIN
    11.098          0.08    128 C5 OLEFIN
    11.149          7.75    129 c-2-PENTENE
    11.620          5.10    133 2.2-DIMETHYLBUTANE
    11.945          0.69    134 C6 OLEFIN
    12.142          0.62    396 C5 OLEFIN
    12.346          1.17      0 Uncalibrated
    12.474          6.05    136 C6 PARAFFIN
    12.592          1.63    138 CYCLOPENTANE
    12.792         11.26    139 2.3-DIMETHYLBUTANE
    12.910          6.55      0 Uncalibrated
    12.962         27.53    141 2-METHYLPENTANE
    13.209         16.66    407 C6 PARAFFIN
    13.284         12.49    369 C6 PARAFFIN
    13.517          1.46    145 3-METHYLPENTANE
    13.695          0.70    146 C6 OLEFIN
    13.764          1.90    344 C6 OLEFIN
    13.905         10.70    147 C6 OLEFIN
    14.077          0.44      0 Uncalibrated
    14.159          0.48    148 n-HEXANE
    14.594          0.19    153 C7 OLEFIN
    14.747         13.84    155 C7 OLEFIN
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TOTAL NMOC = 4,082 ppm

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Retention Concentration
   Time                      CAL# Compound Name

    14.931          0.91    386 C7 PARAFFIN
    15.028          2.15    157 2,4-DIMETHYLPENTANE
    15.077          4.01    158 C7 PARAFFIN
    15.164          2.31    159 C7 OLEFIN
    15.369          0.83    415 C7 OLEFIN
    15.540         17.78    162 BENZENE
    15.655          0.40    387 C7 OLEFIN
    15.758          2.02    163 3,3-DIMETHYLPENTANE
    15.870         54.29    164 CYCLOHEXANE
    16.222          7.23    167 2,3-DIMETHYLPENTANE
    16.298          0.74    168 C7 PARAFFIN
    16.464          8.74    170 3-METHYLHEXANE
    16.656          2.27    171 C7 PARAFFIN
    16.746          1.83    365 C7 PARAFFIN
    16.794          4.85    172 C7 PARAFFIN
    16.832          3.71      0 Uncalibrated
    16.893          2.51    173 2,2,4-TRIMETHYLPENTANE
    16.990          5.34    348 C7 OLEFIN
    17.240          5.54    175 n-HEPTANE
    17.562          1.70    177 C8 OLEFIN
    17.648          0.06    178 C8 OLEFIN
    17.878          6.21    179 METHYLCYCLOHEXANE
    17.959          2.93    366 C8 PARAFFIN
    18.097          0.42      0 Uncalibrated
    18.185          0.26    351 C8 OLEFIN
    18.242          1.44    180 C8 PARAFFIN
    18.312          0.75    181 C8 PARAFFIN
    18.506          1.51    182 C8 PARAFFIN
    18.643          0.07    397 C8 PARAFFIN
    18.726          2.95    183 C8 PARAFFIN
    18.812          0.89    184 2,3,4-TRIMETHYLPENTANE
    18.938         38.37    185 TOLUENE
    19.029          3.85    388 C8 PARAFFIN
    19.113          0.78    187 C8 PARAFFIN
    19.283          4.33    189 C8 PARAFFIN
    19.382          2.56    352 C8 PARAFFIN
    19.510          2.86    191 C8 PARAFFIN
    19.641          9.89    192 C8 PARAFFIN
    19.887          1.68      0 Uncalibrated
    19.934          1.08    194 C8 PARAFFIN
    19.976          1.93    353 C8 PARAFFIN
    20.030          1.43    195 C8 PARAFFIN
    20.108          0.67    196 C8 PARAFFIN
    20.207          7.05    197 C8 PARAFFIN
    20.267          3.39    198 n-OCTANE
    20.361          0.48    199 C9 PARAFFIN
    20.476          3.38    354 C9 OLEFIN
    20.607          0.65    201 C9 PARAFFIN
    20.794          0.73    202 C9 PARAFFIN
    20.894          1.22    203 C9 OLEFIN
    20.954          0.76    204 C9 PARAFFIN
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Retention Time	Concentration	CAL#	Compound Name
21.125	2.45	206	C9 PARAFFIN
21.174	1.54	207	C9 PARAFFIN
21.227	1.46	208	C9 PARAFFIN
21.320	1.86	209	C9 PARAFFIN
21.376	3.98	210	C9 PARAFFIN
21.463	0.42	211	C9 PARAFFIN
21.539	1.49	212	C9 PARAFFIN
21.704	12.61	213	ETHYLBENZENE
21.800	1.05	214	C9 PARAFFIN
21.841	1.19	399	C9 PARAFFIN
21.935	39.85	215	m&p-XYLENE
22.133	22.60	367	C9 PARAFFIN
22.217	3.77	217	C9 PARAFFIN
22.290	5.64	218	C9 PARAFFIN
22.436	767.92	220	C9 OLEFIN
22.572	18.44	222	o-XYLENE
22.708	2.80	224	C9 PARAFFIN
22.752	1.38	225	C9 PARAFFIN
22.822	1.06	226	C9 PARAFFIN
22.903	1.19	227	C9 PARAFFIN
23.011	9.25	228	n-NONANE
23.210	5.82	230	C10 PARAFFIN
23.280	8.74	231	C10 PARAFFIN
23.342	2.40	0	Uncalibrated
23.404	11.18	232	C10 PARAFFIN
23.524	5.39	233	C10 PARAFFIN
23.609	4.97	234	C10 PARAFFIN
23.727	8.72	400	C10 PARAFFIN
23.923	134.57	238	C10 PARAFFIN
23.990	20.05	239	C10 OLEFIN
24.088	2.74	240	C10 OLEFIN
24.151	2.32	241	C10 PARAFFIN
24.195	6.69	242	n-PROPYLBENZENE
24.373	10.65	244	p-ETHYLTOLUENE
24.436	8.20	245	m-ETHYLTOLUENE
24.567	7.59	246	C9 AROMATIC
24.613	3.80	247	C10 PARAFFIN
24.670	8.55	248	C10 PARAFFIN
24.808	21.70	249	o-ETHYLTOLUENE
25.056	5.96	251	C10 PARAFFIN
25.126	52.29	252	C10 OLEFIN
25.210	21.84	253	1,2,4-TRIMETHYLBENZENE
25.303	2.38	254	C9 AROMATIC
25.408	9.49	255	C10 PARAFFIN
25.517	13.42	256	n-DECANE
25.587	1.67	257	C9 AROMATIC
25.658	3.25	258	C9 AROMATIC
25.777	0.78	259	C9 AROMATIC
25.912	54.25	260	1,2,3-TRIMETHYLBENZENE
26.102	6.14	263	C11 PARAFFIN
26.209	14.75	264	C10 AROMATIC

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Retention Time	Concentration	CAL#	Compound Name
26.380	9.25	265	C10 AROMATIC
26.555	32.27	267	C10 AROMATIC
26.671	3.55	0	Uncalibrated
26.713	6.36	268	C10 AROMATIC
26.834	2.03	270	C10 AROMATIC
26.882	1.40	271	C11 PARAFFIN
26.955	4.01	272	C10 AROMATIC
27.010	18.55	273	C11 PARAFFIN
27.132	7.56	274	C11 PARAFFIN
27.186	6.73	275	C10 AROMATIC
27.229	7.17	276	1,2-DIMETHYL-4-ETHYLBENZENE
27.366	6.15	277	C10 AROMATIC
27.456	12.61	355	C11 OLEFIN
27.539	2.17	356	C10 AROMATIC
27.597	3.74	279	C11 PARAFFIN
27.715	3.25	280	C10 AROMATIC
27.758	3.49	281	C10 AROMATIC
27.815	14.66	282	1,2-DIMETHYL-3-ETHYLBENZENE
27.872	8.21	403	C10 AROMATIC
28.121	7.21	285	1,2,3,5-TETRAMETHYLBENZENE
28.201	11.57	286	C10 AROMATIC
28.365	4.08	288	C10 AROMATIC
28.465	4.34	374	C10 AROMATIC
28.510	2.20	357	C10 AROMATIC
28.626	8.77	290	C11 AROMATIC
28.735	6.17	292	C11 AROMATIC
28.865	9.82	293	C11 AROMATIC
28.928	5.76	294	C11 AROMATIC
29.039	39.80	380	C11 AROMATIC
29.125	8.59	296	C11 AROMATIC
29.211	5.70	297	C11 AROMATIC
29.278	1.12	298	C11 AROMATIC
29.362	4.33	299	C11 AROMATIC
29.458	3.90	377	C11 AROMATIC
29.580	227.24	300	C11 AROMATIC
29.724	13.40	301	C11 AROMATIC
29.840	4.85	302	C11 AROMATIC
29.893	3.84	303	C11 AROMATIC
29.947	20.50	304	C12 PARAFFIN
30.085	2.54	305	C11 AROMATIC
30.218	0.03	307	C11 AROMATIC
30.281	7.77	416	C11 AROMATIC
30.457	1.71	359	C11 AROMATIC
30.604	1.41	310	C11 AROMATIC
30.657	1.14	360	C11 AROMATIC
30.770	2.26	312	C12 PARAFFIN
30.914	1.38	314	C12 AROMATIC
30.995	1.75	361	C12 AROMATIC
31.227	0.12	317	C12 AROMATIC
31.310	3.12	318	C12 AROMATIC
31.513	2.06	320	C12 AROMATIC

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Retention Time	Concentration	CAL#	Compound Name
31.617	2.38	321	C12 AROMATIC
31.687	1.60	322	C12 AROMATIC
31.797	0.57	362	C12 AROMATIC
31.937	11.63	323	C12 AROMATIC
32.227	0.74	326	C12 AROMATIC
32.327	1.42	327	C12 AROMATIC
32.390	0.21	328	C13 PRAFFIN
32.530	0.56	329	C12 AROMATIC
32.628	1.19	330	C12 AROMATIC
32.711	1.69	331	C12 AROMATIC
32.822	0.59	332	C12 AROMATIC
32.923	12.16	333	C12 AROMATIC
33.069	4.61	334	C12 AROMATIC
33.152	8.01	336	C12 AROMATIC
33.233	4.40	0	Uncalibrated
33.298	5.06	410	C12 AROMATIC
33.400	8.87	381	C12 AROMATIC
33.450	10.60	337	C12 AROMATIC
33.573	2.17	0	Uncalibrated
33.758	12.54	0	Uncalibrated
33.810	33.79	338	C12 AROMATIC
33.927	1.01	339	C12 AROMATIC
34.020	10.67	0	Uncalibrated
34.086	1.74	0	Uncalibrated
34.148	1.44	0	Uncalibrated
34.291	15.02	411	C12 AROMATIC
34.363	11.62	0	Uncalibrated
34.437	2.47	390	C12 AROMATIC
34.484	1.44	0	Uncalibrated
34.535	2.10	405	C12 AROMATIC
34.720	1.19	0	Uncalibrated
34.760	2.17	0	Uncalibrated
34.843	4.24	0	Uncalibrated
34.926	0.66	0	Uncalibrated
35.301	0.40	378	C12 AROMATIC
35.376	1.10	0	Uncalibrated
35.508	2.91	0	Uncalibrated
35.793	0.68	406	C12 AROMATIC

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TOTAL NMOC = 8.830 ppm

Retention Time	Concentration	CAL#	Compound Name
1.883	9.32	101	ETHANE
1.988	31.35	0	Uncalibrated
2.981	5.88	104	PROPENE
3.087	45.33	105	PROPANE
3.522	0.12	107	PARAFFIN
4.398	0.55	383	C3 PARAFFIN
5.093	14.41	110	ISOBUTANE
5.620	0.26	112	Unknown
6.142	7.42	113	2-METHYL PROPYLENE
6.287	0.56	114	BUTENE-1
6.452	40.44	115	n-BUTANE
6.820	0.35	0	Uncalibrated
6.935	1.11	116	t-2-BUTENE
7.261	0.51	384	C4 PARAFFIN
7.501	0.75	117	c-2-BUTENE
9.399	30.33	119	ISOPENTANE
9.652	0.12	120	C5 OLEFIN
10.001	0.59	121	1-PENTENE
10.112	3.85	394	C5 OLEFIN
10.275	2.26	123	2-METHYL-1-BUTENE
10.412	29.12	124	n-PENTANE
10.562	1.02	125	ISOPRENE
10.671	3.32	126	t-2-PENTENE
10.999	0.37	127	C5 OLEFIN
11.107	2.07	128	C5 OLEFIN
11.160	1.06	129	c-2-PENTENE
11.437	0.22	131	C6 PARAFFIN
11.530	10.19	132	C6 PARAFFIN
11.873	0.86	0	Uncalibrated
11.955	0.71	134	C6 OLEFIN
12.186	0.34	135	C6 OLEFIN
12.354	1.22	385	C6 PARAFFIN
12.425	0.36	136	C6 PARAFFIN
12.568	11.35	138	CYCLOPENTANE
12.701	5.21	139	2,3-DIMETHYLBUTANE
12.895	23.94	141	2-METHYLPENTANE
13.072	18.48	407	C6 PARAFFIN
13.313	5.42	144	C6 OLEFIN
13.376	26.98	145	3-METHYLPENTANE
13.608	2.18	344	C6 OLEFIN
13.786	0.23	147	C6 OLEFIN
13.997	30.19	148	n-HEXANE
14.168	0.87	150	C7 OLEFIN
14.251	1.05	151	C7 OLEFIN
14.343	0.55	152	C7 OLEFIN
14.477	0.28	153	C7 OLEFIN
14.686	0.68	155	C7 OLEFIN
14.837	49.76	156	METHYLCYCLOPENTANE
15.021	4.14	157	2,4-DIMETHYLPENTANE
15.116	29.13	158	C7 PARAFFIN
15.252	0.45	159	C7 OLEFIN

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Retention Time	Concentration	CAL#	Compound Name
15.471	0.41	160	C7 OLEFIN
15.626	17.25	162	BENZENE
15.758	0.15	387	C7 OLEFIN
15.826	1.16	163	3,3-DIMETHYLPENTANE
15.922	89.24	164	CYCLOHEXANE
16.267	20.15	166	2-METHYLHEXANE
16.307	15.34	167	2,3-DIMETHYLPENTANE
16.384	8.88	168	C7 PARAFFIN
16.542	29.83	170	3-METHYLHEXANE
16.637	0.90	347	C7 PARAFFIN
16.733	27.66	171	C7 PARAFFIN
16.821	27.20	365	C7 PARAFFIN
16.910	62.68	172	C7 PARAFFIN
17.066	6.23	348	C7 OLEFIN
17.312	52.02	175	n-HEPTANE
17.465	1.03	176	C8 PARAFFIN
17.619	14.98	177	C8 OLEFIN
17.717	0.37	178	C8 OLEFIN
17.944	98.19	179	METHYLCYCLOHEXANE
18.033	24.84	366	C8 PARAFFIN
18.302	21.00	180	C8 PARAFFIN
18.372	8.88	181	C8 PARAFFIN
18.563	28.82	182	C8 PARAFFIN
18.784	45.40	183	C8 PARAFFIN
18.865	6.98	184	2,3,4-TRIMETHYLPENTANE
18.995	167.18	185	TOLUENE
19.173	6.34	187	C8 PARAFFIN
19.233	9.48	188	C8 PARAFFIN
19.333	37.24	189	C8 PARAFFIN
19.445	2.11	352	C8 PARAFFIN
19.560	26.91	191	C8 PARAFFIN
19.672	63.79	192	C8 PARAFFIN
19.722	16.46	0	Uncalibrated
19.902	11.37	193	C8 PARAFFIN
19.973	11.92	194	C8 PARAFFIN
20.075	32.70	195	C8 PARAFFIN
20.153	3.12	196	C8 PARAFFIN
20.252	30.95	197	C8 PARAFFIN
20.309	58.28	198	n-OCTANE
20.356	83.59	199	C9 PARAFFIN
20.449	15.28	200	C9 PARAFFIN
20.645	8.64	201	C9 PARAFFIN
20.752	0.99	289	C9 PARAFFIN
20.817	7.70	202	C9 PARAFFIN
20.933	18.47	203	C9 OLEFIN
20.990	4.48	204	C9 PARAFFIN
21.160	43.33	206	C9 PARAFFIN
21.208	7.12	207	C9 PARAFFIN
21.260	37.97	208	C9 PARAFFIN
21.347	13.10	209	C9 PARAFFIN
21.410	84.37	210	C9 PARAFFIN

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Retention Concentration
   Time                 CAL# Compound Name


  21.497          15.91  211 C9 PARAFFIN
  21.577          10.32  212 C9 PARAFFIN
  21.734          75.89  213 ETHYLBENZENE
  21.828          26.41  214 C9 PARAFFIN
  21.965         198.60  215 m&p-XYLENE
  22.127          35.67  216 C9 PARAFFIN
  22.205          12.41  217 C9 PARAFFIN
  22.317          38.08  218 C9 PARAFFIN
  22.469        1144.41  220 C9 OLEFIN
  22.600          68.81  222 o-XYLENE
  22.736          37.36  224 C9 PARAFFIN
  22.776          25.02  225 C9 PARAFFIN
  22.845          15.45  226 C9 PARAFFIN
  22.927          11.09  227 C9 PARAFFIN
  23.030         368.72  228 n-NONANE
  23.155         117.46  229 C10 PARAFFIN
  23.300          67.52  231 C10 PARAFFIN
  23.371          13.80    0 Uncalibrated
  23.402          12.78    0 Uncalibrated
  23.450          20.92  232 C10 PARAFFIN
  23.531          21.19  233 C10 PARAFFIN
  23.627          65.01  234 C10 PARAFFIN
  23.717          14.18  235 C10 PARAFFIN
  23.792          15.30  400 C10 PARAFFIN
  23.883          38.17  237 C10 PARAFFIN
  23.942         297.44  238 C10 PARAFFIN
  24.014          38.51  239 C10 OLEFIN
  24.164          36.41  241 C10 PARAFFIN
  24.212          32.01  242 n-PROPYLBENZENE
  24.302          13.65  243 C10 PARAFFIN
  24.388          56.15  244 p-ETHYLTOLUENE
  24.452          45.13  245 m-ETHYLTOLUENE
  24.581          39.87  246 C9 AROMATIC
  24.664          98.09  247 C10 PARAFFIN
  24.853          56.83  249 o-ETHYLTOLUENE
  24.900          11.72    0 Uncalibrated
  25.023          36.49    0 Uncalibrated
  25.067          17.86  251 C10 PARAFFIN
  25.138         167.07  252 C10 OLEFIN
  25.227         107.81  253 1,2,4-TRIMETHYLBENZENE
  25.320          28.81  254 C9 AROMATIC
  25.403          47.38  255 C10 PARAFFIN
  25.527          91.49  256 n-DECANE
  25.596          14.67  257 C9 AROMATIC
  25.666          21.66  258 C9 AROMATIC
  25.787          12.29  259 C9 AROMATIC
  25.911         186.83  260 1,2,3-TRIMETHYLBENZENE
  26.108          57.31  263 C11 PARAFFIN
  26.222          43.51  264 C10 AROMATIC
  26.280          16.95    0 Uncalibrated
  26.400          57.88  265 C10 AROMATIC
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Retention Concentration
   Time                 CAL# Compound Name


  26.541         137.55  266 C10 AROMATIC
  26.673          21.02  401 C10 AROMATIC
  26.718          26.02  268 C10 AROMATIC
  26.845          26.87  270 C10 AROMATIC
  26.961          15.44  272 C10 AROMATIC
  27.045          64.81  273 C11 PARAFFIN
  27.140          28.48  373 C10 AROMATIC
  27.190          36.84  275 C10 AROMATIC
  27.237          29.14  276 1,2-DIMETHYL-4-ETHYLBENZENE
  27.308           7.98  402 C10 AROMATIC
  27.371          28.02  277 C10 AROMATIC
  27.453          32.43  278 C10 AROMATIC
  27.494          31.24  355 C11 OLEFIN
  27.543          15.22  356 C10 AROMATIC
  27.605          34.38  279 C11 PARAFFIN
  27.670           6.11  280 C10 AROMATIC
  27.763          26.60  281 C10 AROMATIC
  27.818          91.22  282 1,2-DIMETHYL-3-ETHYLBENZENE
  27.868          16.09  403 C10 AROMATIC
  27.915          14.01    0 Uncalibrated
  27.972          18.51  283 C10 AROMATIC
  28.122          46.87  285 1,2,3,5-TETRAMETHYLBENZENE
  28.207          57.29  286 C10 AROMATIC
  28.367          39.76  288 C10 AROMATIC
  28.468          36.97  374 C10 AROMATIC
  28.626          41.16  290 C11 AROMATIC
  28.740          54.85  292 C11 AROMATIC
  28.870          44.16  293 C11 AROMATIC
  28.930          23.97  294 C11 AROMATIC
  29.038         489.31  380 C11 AROMATIC
  29.128          31.39  296 C11 AROMATIC
  29.213          39.08  297 C11 AROMATIC
  29.273          14.88  298 C11 AROMATIC
  29.356          22.12  299 C11 AROMATIC
  29.459          22.24  377 C11 AROMATIC
  29.591         614.15  300 C11 AROMATIC
  29.716          45.76  301 C11 AROMATIC
  29.832          35.05  302 C11 AROMATIC
  29.894          26.39  303 C11 AROMATIC
  29.949          76.15  304 C12 PARAFFIN
  30.085          18.64  305 C11 AROMATIC
  30.161           8.61  306 C11 AROMATIC
  30.282          59.94  416 C11 AROMATIC
  30.457          13.20  359 C11 AROMATIC
  30.599           8.25  310 C11 AROMATIC
  30.656           8.56  360 C11 AROMATIC
  30.770          21.35  311 C11 AROMATIC
  30.874          11.64  313 C11 AROMATIC
  30.915          10.69  314 C12 AROMATIC
  30.997          16.43  361 C12 AROMATIC
  31.059           3.92  315 C12 AROMATIC
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Retention Concentration
     Time                    CAL# Compound Name


   31.158          6.14   316 C12 AROMATIC
   31.217         10.98     0 Uncalibrated
   31.308         19.51   318 C12 AROMATIC
   31.450          2.47     0 Uncalibrated
   31.515          6.11   320 C12 AROMATIC
   31.622          7.17   321 C12 AROMATIC
   31.800          2.46   362 C12 AROMATIC
   31.935         36.22   323 C12 AROMATIC
   32.107          4.52   325 C12 AROMATIC
   32.300          5.41     0 Uncalibrated
   32.391          0.31   328 C13 FRAFFIN
   32.491          1.64   404 C12 AROMATIC
   32.687         20.02   330 C12 AROMATIC
   32.867          1.44   332 C12 AROMATIC
   32.911          4.44   333 C12 AROMATIC
   33.063          1.53   334 C12 AROMATIC
   33.152          1.47   336 C12 AROMATIC
   33.225          0.37     0 Uncalibrated
   33.297          1.31   410 C12 AROMATIC
   33.402          0.98   381 C12 AROMATIC
   33.449          3.13   337 C12 AROMATIC
   33.805         21.97   338 C12 AROMATIC
   33.923          0.97   339 C12 AROMATIC
   34.030          1.89     0 Uncalibrated
   34.300          3.02   411 C12 AROMATIC
   34.377          1.97     0 Uncalibrated
   34.435          0.53   390 C12 AROMATIC
   34.640          0.27   405 C12 AROMATIC
   34.712          0.58     0 Uncalibrated
   34.757          0.54     0 Uncalibrated
   34.840          3.06     0 Uncalibrated
   35.379          0.50   378 C12 AROMATIC
   35.506          1.90     0 Uncalibrated
   35.722          3.02   406 C12 AROMATIC
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Peak Identification Report

TOTAL NMOC = 4.420 ppm

Retention Time	Concentration	CAL#	Compound Name
1.697	0.52	0	Uncalibrated
1.859	0.63	0	Uncalibrated
1.972	66.83	101	ETHANE
2.964	5.11	104	PROPENE
3.062	126.05	105	PROPANE
5.075	81.46	110	ISOBUTANE
6.108	0.29	113	2-METHYL PROPYLENE
6.442	164.94	115	n-BUTANE
6.947	2.68	116	t-2-BUTENE
7.259	0.43	341	C4 OLEFIN
7.497	2.06	117	c-2-BUTENE
8.740	0.17	118	C4 OLEFIN
9.397	25.98	119	ISOPENTANE
10.017	1.29	121	1-PENTENE
10.123	2.43	394	C5 OLEFIN
10.276	2.16	123	2-METHYL-1-BUTENE
10.412	19.34	124	n-PENTANE
10.748	2.21	126	t-2-PENTENE
11.002	0.65	127	C5 OLEFIN
11.079	0.07	128	C5 OLEFIN
11.168	1.70	129	c-2-PENTENE
11.611	6.95	132	C6 PARAFFIN
11.963	0.46	134	C6 OLEFIN
12.078	0.36	396	C5 OLEFIN
12.623	2.52	138	CYCLOPENTANE
12.761	0.91	139	2,3-DIMETHYLBUTANE
12.959	6.82	141	2-METHYLPENTANE
13.115	0.42	143	C6 OLEFIN
13.168	12.72	407	C6 PARAFFIN
13.436	10.04	145	3-METHYLPENTANE
13.674	0.12	344	C6 OLEFIN
13.853	0.10	147	C6 OLEFIN
14.058	5.95	148	n-HEXANE
14.140	0.75	149	C7 PARAFFIN
14.313	0.12	151	C7 OLEFIN
14.760	0.13	155	C7 OLEFIN
14.892	5.73	156	METHYLCYCLOPENTANE
14.947	1.83	386	C7 PARAFFIN
15.083	0.51	157	2,4-DIMETHYLPENTANE
15.209	6.74	158	C7 PARAFFIN
15.312	0.72	159	C7 OLEFIN
15.535	0.45	160	C7 OLEFIN
15.680	23.76	162	BENZENE
15.997	32.45	164	CYCLOHEXANE
16.321	0.72	166	2-METHYLHEXANE
16.598	3.72	170	3-METHYLHEXANE
16.780	1.27	171	C7 PARAFFIN
16.867	1.17	365	C7 PARAFFIN
16.920	1.73	172	C7 PARAFFIN
16.955	2.44	0	Uncalibrated
17.114	5.28	348	C7 OLEFIN

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Peak Identification Report

Retention Time	Concentration	CAL#	Compound Name
17.356	3.70	175	n-HEPTANE
17.661	14.24	177	C8 OLEFIN
17.982	4.25	179	METHYLCYCLOHEXANE
18.073	1.68	366	C8 PARAFFIN
18.198	1.30	351	C8 OLEFIN
18.340	0.96	180	C8 PARAFFIN
18.415	0.86	181	C6 PARAFFIN
18.597	0.84	182	C8 PARAFFIN
18.814	3.37	183	C8 PARAFFIN
18.900	1.16	184	2,3,4-TRIMETHYLPENTANE
19.025	26.08	185	TOLUENE
19.158	1.95	388	C8 PARAFFIN
19.243	0.73	188	C8 PARAFFIN
19.362	2.15	189	C8 PARAFFIN
19.470	0.96	352	C8 PARAFFIN
19.587	1.36	191	C8 PARAFFIN
19.717	8.72	192	C8 PARAFFIN
19.907	0.65	193	C8 PARAFFIN
19.955	0.79	0	Uncalibrated
20.002	0.69	194	C8 PARAFFIN
20.100	0.62	195	C8 PARAFFIN
20.282	2.95	197	C8 PARAFFIN
20.331	2.67	198	n-OCTANE
20.379	4.15	199	C9 PARAFFIN
20.480	0.44	200	C9 PARAFFIN
20.524	1.04	354	C9 OLEFIN
20.668	0.32	201	C9 PARAFFIN
20.842	1.10	202	C9 PARAFFIN
20.953	41.32	203	C9 OLEFIN
21.170	1.70	206	C9 PARAFFIN
21.227	0.17	207	C9 PARAFFIN
21.280	0.79	208	C9 PARAFFIN
21.370	0.30	209	C9 PARAFFIN
21.428	2.54	210	C9 PARAFFIN
21.650	0.41	212	C9 PARAFFIN
21.750	13.43	213	ETHYLBENZENE
21.843	1.81	214	C9 PARAFFIN
21.980	29.43	215	m&p-XYLENE
22.177	5.68	367	C9 PARAFFIN
22.252	1.56	217	C9 PARAFFIN
22.331	1.60	218	C9 PARAFFIN
22.480	1160.33	220	C9 OLEFIN
22.613	21.10	222	o-XYLENE
22.737	2.92	224	C9 PARAFFIN
22.856	0.71	226	C9 PARAFFIN
22.940	0.57	227	C9 PARAFFIN
22.984	0.97	0	Uncalibrated
23.047	14.49	228	n-NONANE
23.151	46.25	229	C10 PARAFFIN
23.391	2.88	0	Uncalibrated
23.459	5.63	232	C10 PARAFFIN

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Retention Concentration
   Time
                       CAL# Compound Name

  23.529          1.55  233 C10 PARAFFIN
  23.637          1.69  234 C10 PARAFFIN
  23.742          0.72  235 C10 PARAFFIN
  23.948        194.44  238 C10 PARAFFIN
  24.013         17.15  239 C10 OLEFIN
  24.119          1.27  240 C10 OLEFIN
  24.221          6.21  242 n-PROPYLBENZENE
  24.315          0.59  243 C10 PARAFFIN
  24.395         11.02  244 p-ETHYLTOLUENE
  24.454          6.46  245 m-ETHYLTOLUENE
  24.588          5.96  246 C9 AROMATIC
  24.672          7.71  247 C10 PARAFFIN
  24.827         17.67  249 o-ETHYLTOLUENE
  25.077          4.58  251 C10 PARAFFIN
  25.143        150.19  252 C10 OLEFIN
  25.228         23.07  253 1,2,4-TRIMETHYLBENZENE
  25.324          2.05  254 C9 AROMATIC
  25.413         55.19  255 C10 PARAFFIN
  25.530         11.62  256 n-DECANE
  25.602          1.92  257 C9 AROMATIC
  25.669          2.31  258 C9 AROMATIC
  25.793          1.33  259 C9 AROMATIC
  25.907         37.56  260 1,2,3-TRIMETHYLBENZENE
  25.970          5.87  261 C11 PARAFFIN
  26.111          6.52  263 C11 PARAFFIN
  26.223         21.47  264 C10 AROMATIC
  26.391         16.10  265 C10 AROMATIC
  26.551         68.60  267 C10 AROMATIC
  26.679          5.92  401 C10 AROMATIC
  26.722          7.50  268 C10 AROMATIC
  26.849          5.77  270 C10 AROMATIC
  26.967          4.79  272 C10 AROMATIC
  27.017         31.93  273 C11 PARAFFIN
  27.144         21.68  373 C10 AROMATIC
  27.188         57.83  275 C10 AROMATIC
  27.372          9.08  277 C10 AROMATIC
  27.465         14.72  278 C10 AROMATIC
  27.496         23.40  355 C11 OLEFIN
  27.604          7.12  279 C11 PARAFFIN
  27.764         13.86  281 C10 AROMATIC
  27.819         19.35  282 1,2-DIMETHYL-3-ETHYLBENZENE
  27.880          8.63  403 C10 AROMATIC
  27.935          6.38  283 C10 AROMATIC
  28.054          2.28  284 1,2,4,5-TETRAMETHYLBENZENE
  28.122         14.61  285 1,2,3,5-TETRAMETHYLBENZENE
  28.207         18.41  286 C10 AROMATIC
  28.371          8.40  288 C10 AROMATIC
  28.466         16.11  374 C10 AROMATIC
  28.632         15.80  290 C11 AROMATIC
  28.740         10.85  292 C11 AROMATIC
  28.822          7.49    0 Uncalibrated
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Retention Concentration
   Time
                       CAL# Compound Name

  28.871         13.11  293 C11 AROMATIC
  28.934         10.06  294 C11 AROMATIC
  29.038        381.73  380 C11 AROMATIC
  29.129         19.59  296 C11 AROMATIC
  29.214          9.00  297 C11 AROMATIC
  29.281          3.35  298 C11 AROMATIC
  29.355          6.17  299 C11 AROMATIC
  29.430         16.30  377 C11 AROMATIC
  29.591        504.26  300 C11 AROMATIC
  29.704         20.57  301 C11 AROMATIC
  29.846          6.56  302 C11 AROMATIC
  29.897          6.00  303 C11 AROMATIC
  29.949         22.31  304 C12 PARAFFIN
  30.086          3.47  305 C11 AROMATIC
  30.167          0.67  306 C11 AROMATIC
  30.282          9.60  416 C11 AROMATIC
  30.405          0.14  309 C11 AROMATIC
  30.454          2.13  359 C11 AROMATIC
  30.605          2.39  310 C11 AROMATIC
  30.655          3.11  360 C11 AROMATIC
  30.775          5.56  312 C12 PARAFFIN
  30.875          3.52  313 C11 AROMATIC
  30.911          3.08  314 C12 AROMATIC
  30.994          5.12  361 C12 AROMATIC
  31.075          2.99  315 C12 AROMATIC
  31.210          3.41  316 C12 AROMATIC
  31.307         12.19  318 C12 AROMATIC
  31.439          3.95  319 C12 AROMATIC
  31.509          3.07  320 C12 AROMATIC
  31.599          7.65    0 Uncalibrated
  31.677          2.84  322 C12 AROMATIC
  31.794          0.78  362 C12 AROMATIC
  31.930         21.33  323 C12 AROMATIC
  32.106          1.33  325 C12 AROMATIC
  32.277          3.87  326 C12 AROMATIC
  32.487          3.00  404 C12 AROMATIC
  32.635          1.54  330 C12 AROMATIC
  32.709          0.65  331 C12 AROMATIC
  32.813          1.48  332 C12 AROMATIC
  32.918         11.92    0 Uncalibrated
  32.967          4.49  333 C12 AROMATIC
  33.067          6.35  334 C12 AROMATIC
  33.155          8.50  336 C12 AROMATIC
  33.230          2.99    0 Uncalibrated
  33.297          6.46  410 C12 AROMATIC
  33.400          5.89  381 C12 AROMATIC
  33.450         13.17  337 C12 AROMATIC
  33.510          1.05    0 Uncalibrated
  33.572          3.70    0 Uncalibrated
  33.801         55.46  338 C12 AROMATIC
  33.922          3.62  339 C12 AROMATIC
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Retention Concentration
   Time                 CAL# Compound Name


  33.967           2.58    0 Uncalibrated
  34.020          10.08    0 Uncalibrated
  34.097           4.58    0 Uncalibrated
  34.293           6.74    0 Uncalibrated
  34.367           3.03  411 C12 AROMATIC
  34.434           0.66  390 C12 AROMATIC
  34.487           0.11    0 Uncalibrated
  34.543           0.82    0 Uncalibrated
  34.635           1.39  405 C12 AROMATIC
  34.707           1.49    0 Uncalibrated
  34.843           8.46    0 Uncalibrated
  34.929           0.72    0 Uncalibrated
  35.042           1.58    0 Uncalibrated
  35.190           0.83    0 Uncalibrated
  35.296           0.36  378 C12 AROMATIC
  35.376           0.85    0 Uncalibrated
  35.504           3.18    0 Uncalibrated
  35.632           0.85    0 Uncalibrated
  35.706           2.27    0 Uncalibrated
  35.918           0.47  406 C12 AROMATIC
  36.177           0.26  340 C12 AROMATIC
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GGC STUDY 7/15/85 GGC11

Peak Identification Report

TOTAL NMOC = 4.941 ppm

Retention Time	Concentration	CAL#	Compound Name
1.713	0.51	0	Uncalibrated
1.864	4.38	102	ETHYLENE
1.970	71.11	101	ETHANE
2.960	15.02	104	PROPENE
3.065	113.20	105	PROPANE
5.078	41.91	110	ISOBUTANE
6.105	15.00	113	2-METHYL PROPYLENE
6.312	0.51	114	BUTENE-1
6.444	89.39	115	n-BUTANE
6.928	2.34	116	t-2-BUTENE
7.258	0.51	384	C4 PARAFFIN
7.495	2.13	117	c-2-BUTENE
7.800	0.08	0	Uncalibrated
8.547	0.03	0	Uncalibrated
9.396	20.53	119	ISOPENTANE
10.000	2.15	121	1-PENTENE
10.111	6.99	394	C5 OLEFIN
10.270	10.89	123	2-METHYL-1-BUTENE
10.408	17.09	124	n-PENTANE
10.557	0.13	125	ISOPRENE
10.739	0.75	126	t-2-PENTENE
10.831	1.80	413	C5 OLEFIN
11.157	11.91	129	c-2-PENTENE
11.523	14.37	131	C6 PARAFFIN
12.037	0.84	134	C6 OLEFIN
12.480	0.65	136	C6 PARAFFIN
12.618	2.32	138	CYCLOPENTANE
12.754	0.71	139	2,3-DIMETHYLBUTANE
12.951	7.90	141	2-METHYLPENTANE
13.115	53.44	407	C6 PARAFFIN
13.326	2.70	369	C6 PARAFFIN
13.429	12.76	145	3-METHYLPENTANE
13.665	0.63	344	C6 OLEFIN
13.840	0.62	147	C6 OLEFIN
14.053	6.18	148	n-HEXANE
14.305	0.33	151	C7 OLEFIN
14.674	0.96	0	Uncalibrated
14.740	0.22	155	C7 OLEFIN
14.891	7.87	156	METHYLCYCLOPENTANE
15.077	0.23	157	2,4-DIMETHYLPENTANE
15.160	13.91	158	C7 PARAFFIN
15.292	2.02	159	C7 OLEFIN
15.515	0.67	160	C7 OLEFIN
15.675	9.24	162	BENZENE
15.800	0.13	387	C7 OLEFIN
15.891	0.35	163	3,3-DIMETHYLPENTANE
15.964	107.00	164	CYCLOHEXANE
16.313	2.26	166	2-METHYLHEXANE
16.359	5.12	167	2,3-DIMETHYLPENTANE
16.590	7.13	170	3-METHYLHEXANE
16.672	1.29	347	C7 PARAFFIN

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Peak Identification Report

Retention Time	Concentration	CAL#	Compound Name
16.776	1.64	171	C7 PARAFFIN
16.865	1.13	365	C7 PARAFFIN
16.912	7.13	172	C7 PARAFFIN
16.998	1.84	173	2,2,4-TRIMETHYLPENTANE
17.111	3.25	348	C7 OLEFIN
17.302	0.59	174	C8 OLEFIN
17.353	3.30	175	n-HEPTANE
17.511	0.26	176	C8 PARAFFIN
17.652	25.19	177	C8 OLEFIN
17.979	3.97	179	METHYLCYCLOHEXANE
18.062	1.77	366	C8 PARAFFIN
18.145	0.21	0	Uncalibrated
18.336	1.06	180	C8 PARAFFIN
18.410	1.15	181	C8 PARAFFIN
18.597	0.81	182	C8 PARAFFIN
18.806	2.73	183	C8 PARAFFIN
18.864	3.71	184	2,3,4-TRIMETHYLPENTANE
19.024	19.29	185	TOLUENE
19.119	0.64	388	C8 PARAFFIN
19.227	0.96	187	C8 PARAFFIN
19.360	1.94	189	C8 PARAFFIN
19.457	1.52	352	C8 PARAFFIN
19.585	1.05	191	C8 PARAFFIN
19.710	9.94	192	C8 PARAFFIN
19.953	1.30	193	C8 PARAFFIN
20.003	2.62	194	C8 PARAFFIN
20.099	0.71	195	C8 PARAFFIN
20.276	2.97	197	C8 PARAFFIN
20.332	2.36	198	n-OCTANE
20.377	4.49	199	C9 PARAFFIN
20.525	1.89	354	C9 OLEFIN
20.666	0.35	201	C9 PARAFFIN
20.723	0.86	389	C9 PARAFFIN
20.950	46.91	203	C9 OLEFIN
21.277	0.84	208	C9 PARAFFIN
21.426	2.43	210	C9 PARAFFIN
21.642	4.46	212	C9 PARAFFIN
21.677	2.34	0	Uncalibrated
21.748	14.09	213	ETHYLBENZENE
21.831	4.96	214	C9 PARAFFIN
21.978	26.73	215	m&p-XYLENE
22.174	5.40	367	C9 PARAFFIN
22.250	2.78	217	C9 PARAFFIN
22.327	1.00	218	C9 PARAFFIN
22.476	955.22	220	C9 OLEFIN
22.608	11.41	222	o-XYLENE
22.742	1.14	224	C9 PARAFFIN
22.855	0.28	226	C9 PARAFFIN
23.040	265.23	228	n-NONANE
23.458	28.68	232	C10 PARAFFIN
23.633	7.01	234	C10 PARAFFIN

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Retention Concentration
    Time                    CAL# Compound Name


    23.740           2.63   235 C10 PARAFFIN
    23.946         219.78   238 C10 PARAFFIN
    24.012          16.79   239 C10 OLEFIN
    24.117           0.87   240 C10 OLEFIN
    24.217           5.65   242 n-PROPYLBENZENE
    24.394          11.85   244 p-ETHYLTOLUENE
    24.453           4.53   245 m-ETHYLTOLUENE
    24.490           2.21     0 Uncalibrated
    24.585           5.56   246 C9 AROMATIC
    24.670           6.64   247 C10 PARAFFIN
    24.823          94.97   249 o-ETHYLTOLUENE
    25.016           1.70   250 C9 AROMATIC
    25.143         162.51   252 C10 OLEFIN
    25.227          20.93   253 1,2,4-TRIMETHYLBENZENE
    25.320           1.33   254 C9 AROMATIC
    25.417          66.84   255 C10 PARAFFIN
    25.531           9.62   256 n-DECANE
    25.604           1.25   257 C9 AROMATIC
    25.672           1.75   258 C9 AROMATIC
    25.788           1.65   259 C9 AROMATIC
    25.880          98.75   408 C9 AROMATIC
    25.969           8.74   261 C11 PARAFFIN
    26.107           6.64   263 C11 PARAFFIN
    26.221          16.82   264 C10 AROMATIC
    26.387          13.14   265 C10 AROMATIC
    26.542          99.92   266 C10 AROMATIC
    26.645           4.84   401 C10 AROMATIC
    26.720           8.94   268 C10 AROMATIC
    26.840           6.07   270 C10 AROMATIC
    27.015          29.29   273 C11 PARAFFIN
    27.153         173.61   274 C11 PARAFFIN
    27.372           8.51   277 C10 AROMATIC
    27.496          45.84   355 C11 OLEFIN
    27.597           9.68   279 C11 PARAFFIN
    27.720           5.76   280 C10 AROMATIC
    27.762           5.53   281 C10 AROMATIC
    27.818          15.85   282 1,2-DIMETHYL-3-ETHYLBENZENE
    27.868           7.67   403 C10 AROMATIC
    27.960           7.42   283 C10 AROMATIC
    28.105          22.90   285 1,2,3,5-TETRAMETHYLBENZENE
    28.207          17.98   286 C10 AROMATIC
    28.372           8.47   288 C10 AROMATIC
    28.467           6.76   374 C10 AROMATIC
    28.514           3.77   357 C10 AROMATIC
    28.630          16.06   290 C11 AROMATIC
    28.741           9.16   292 C11 AROMATIC
    28.817          13.92     0 Uncalibrated
    28.869          12.08   293 C11 AROMATIC
    28.931           9.68   294 C11 AROMATIC
    29.035         363.23   380 C11 AROMATIC
    29.128          17.43   296 C11 AROMATIC
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Page No.     4              GGC STUDY 7/15/85 GGC11
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Retention Concentration
    Time                    CAL# Compound Name


    29.212           8.16   297 C11 AROMATIC
    29.285           4.86   298 C11 AROMATIC
    29.370           8.92   299 C11 AROMATIC
    29.427           8.98   377 C11 AROMATIC
    29.590         552.64   300 C11 AROMATIC
    29.705          26.59   301 C11 AROMATIC
    29.847           8.50   302 C11 AROMATIC
    29.897           6.15   303 C11 AROMATIC
    29.948          21.78   304 C12 PARAFFIN
    30.080           4.94   305 C11 AROMATIC
    30.165           1.60   306 C11 AROMATIC
    30.281          13.32   416 C11 AROMATIC
    30.405          17.39   309 C11 AROMATIC
    30.605           2.65   310 C11 AROMATIC
    30.657           2.79   360 C11 AROMATIC
    30.712           3.34     0 Uncalibrated
    30.777           5.48   312 C12 PARAFFIN
    30.870           4.06   313 C11 AROMATIC
    30.911           3.10   314 C12 AROMATIC
    30.993           5.11   361 C12 AROMATIC
    31.118           7.86   315 C12 AROMATIC
    31.213           2.51   316 C12 AROMATIC
    31.309          13.32   318 C12 AROMATIC
    31.408           2.12   319 C12 AROMATIC
    31.445           2.25     0 Uncalibrated
    31.510           2.69   320 C12 AROMATIC
    31.585           8.55     0 Uncalibrated
    31.687           3.13   322 C12 AROMATIC
    31.797           0.58   362 C12 AROMATIC
    31.926          24.80   323 C12 AROMATIC
    32.105           4.02   325 C12 AROMATIC
    32.269           1.44   326 C12 AROMATIC
    32.329           0.16     0 Uncalibrated
    32.395           2.17   328 C13 PRAFFIN
    32.483           1.97   404 C12 AROMATIC
    32.630           1.43   330 C12 AROMATIC
    32.720          11.29   331 C12 AROMATIC
    32.915          15.69     0 Uncalibrated
    32.966           6.06   333 C12 AROMATIC
    33.065           8.40   334 C12 AROMATIC
    33.153          10.62   336 C12 AROMATIC
    33.226           4.01     0 Uncalibrated
    33.293           8.02   410 C12 AROMATIC
    33.395           7.64   381 C12 AROMATIC
    33.447          14.16   337 C12 AROMATIC
    33.567           2.27     0 Uncalibrated
    33.799          73.98   338 C12 AROMATIC
    33.919           4.32   339 C12 AROMATIC
    34.018          17.97     0 Uncalibrated
    34.093           3.72     0 Uncalibrated
    34.289          11.42     0 Uncalibrated
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Retention Concentration
   Time                 CAL# Compound Name


   34.360          7.92  411 C12 AROMATIC
   34.434          2.82  390 C12 AROMATIC
   34.491          2.05    0 Uncalibrated
   34.545          2.84    0 Uncalibrated
   34.637          2.42  405 C12 AROMATIC
   34.706          2.28    0 Uncalibrated
   34.791          3.56    0 Uncalibrated
   34.845          8.28    0 Uncalibrated
   34.927          0.79    0 Uncalibrated
   35.020          1.06    0 Uncalibrated
   35.195          0.81  378 C12 AROMATIC
   35.295          0.42    0 Uncalibrated
   35.373          1.17    0 Uncalibrated
   35.503          4.48    0 Uncalibrated
   35.634          3.37    0 Uncalibrated
   35.710          4.23    0 Uncalibrated
   35.918          0.54  406 C12 AROMATIC
   36.177          0.15  340 C12 AROMATIC
   37.190          0.35    0 Uncalibrated
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TOTAL NMOC = 12.901 ppm

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Retention Concentration
   Time                  CAL# Compound Name

    1.859         8.26   102 ETHYLENE
    1.966        28.40   101 ETHANE
    2.967         4.81   104 PROPENE
    3.069        45.84   105 PROPANE
    5.083        15.50   110 ISOBUTANE
    6.113         5.22   113 2-METHYL PROPYLENE
    6.326         0.24   114 BUTENE-1
    6.450        42.41   115 n-BUTANE
    6.817         0.39     0 Uncalibrated
    6.952         0.81   116 t-2-BUTENE
    7.263         0.19   341 C4 OLEFIN
    7.500         0.52   117 c-2-BUTENE
    9.396        35.23   119 ISOPENTANE
    9.650         0.12   120 C5 OLEFIN
    9.812        21.49     0 Uncalibrated
    9.996         0.50   121 1-PENTENE
   10.109         3.71   394 C5 OLEFIN
   10.270         2.17   123 2-METHYL-1-BUTENE
   10.407        34.73   124 n-PENTANE
   10.559         0.66   125 ISOPRENE
   10.675         3.09   126 t-2-PENTENE
   11.019         0.37   127 C5 OLEFIN
   11.136         1.30   128 C5 OLEFIN
   11.187         1.10   129 c-2-PENTENE
   11.396        14.14     0 Uncalibrated
   11.585         5.08   132 C6 PARAFFIN
   11.683         2.01   133 2,2-DIMETHYLBUTANE
   12.035         1.42   134 C6 OLEFIN
   12.267         0.36   135 C6 OLEFIN
   12.437         1.36   385 C6 PARAFFIN
   12.499         0.95   136 C6 PARAFFIN
   12.644        14.36   138 CYCLOPENTANE
   12.778         6.07   139 2,3-DIMETHYLBUTANE
   12.972        28.51   141 2-METHYLPENTANE
   13.143        21.64   407 C6 PARAFFIN
   13.262         8.46     0 Uncalibrated
   13.370         9.22   144 C6 OLEFIN
   13.452        31.19   145 3-METHYLPENTANE
   13.687         2.43   344 C6 OLEFIN
   13.865         0.38   147 C6 OLEFIN
   14.074        34.75   148 n-HEXANE
   14.246         0.76   150 C7 OLEFIN
   14.327         1.20   151 C7 OLEFIN
   14.417         0.50   152 C7 OLEFIN
   14.552         0.30   153 C7 OLEFIN
   14.691         0.11     0 Uncalibrated
   14.760         0.60   155 C7 OLEFIN
   14.908        63.58   156 METHYLCYCLOPENTANE
   15.094         5.26   157 2,4-DIMETHYLPENTANE
   15.187        33.46   158 C7 PARAFFIN
   15.315         0.94   159 C7 OLEFIN
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Page No.      2             GGC STUDY 7/15/85 GGC12
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Retention Concentration
   Time                  CAL# Compound Name

   15.534         0.54   160 C7 OLEFIN
   15.693        18.72   162 BENZENE
   15.817         0.25   387 C7 OLEFIN
   15.892         1.40   163 3,3-DIMETHYLPENTANE
   15.987        94.07   164 CYCLOHEXANE
   16.177         3.02   346 C7 OLEFIN
   16.329        22.54   166 2-METHYLHEXANE
   16.368        17.96   167 2,3-DIMETHYLPENTANE
   16.445        10.15   168 C7 PARAFFIN
   16.602        35.37   170 3-METHYLHEXANE
   16.690         1.18   347 C7 PARAFFIN
   16.791        33.10   171 C7 PARAFFIN
   16.878        31.73   365 C7 PARAFFIN
   16.966        78.03   172 C7 PARAFFIN
   17.122         4.13   348 C7 OLEFIN
   17.365        59.15   175 n-HEPTANE
   17.514         1.42   176 C8 PARAFFIN
   17.668        25.18   177 C8 OLEFIN
   17.765         1.10   178 C8 OLEFIN
   17.990       114.07   179 METHYLCYCLOHEXANE
   18.080        27.96   366 C8 PARAFFIN
   18.345        24.28   180 C8 PARAFFIN
   18.415         9.69   181 C8 PARAFFIN
   18.603        33.06   182 C8 PARAFFIN
   18.823        52.41   183 C8 PARAFFIN
   18.903         7.84   184 2,3,4-TRIMETHYLPENTANE
   19.032       209.85   185 TOLUENE
   19.145         3.27   388 C8 PARAFFIN
   19.209         8.29   187 C8 PARAFFIN
   19.268        12.20   188 C8 PARAFFIN
   19.367        52.82   189 C8 PARAFFIN
   19.479         5.36   352 C8 PARAFFIN
   19.592        30.68   191 C8 PARAFFIN
   19.705        97.24   192 C8 PARAFFIN
   19.932        13.00   193 C8 PARAFFIN
   20.004        14.24   194 C8 PARAFFIN
   20.106        37.80   195 C8 PARAFFIN
   20.180         3.35   196 C8 PARAFFIN
   20.280        36.35   197 C8 PARAFFIN
   20.337        66.83   198 n-OCTANE
   20.385        84.16   199 C9 PARAFFIN
   20.477        17.45   200 C9 PARAFFIN
   20.672         9.44   201 C9 PARAFFIN
   20.780         0.74   289 C9 PARAFFIN
   20.841         7.85   202 C9 PARAFFIN
   20.957        22.83   203 C9 OLEFIN
   21.012         5.04   204 C9 PARAFFIN
   21.182        49.42   206 C9 PARAFFIN
   21.231         8.64   207 C9 PARAFFIN
   21.282        42.81   208 C9 PARAFFIN
   21.369        15.11   209 C9 PARAFFIN
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Peak Identification Report

Retention Time	Concentration	CAL#	Compound Name
21.432	96.07	210	C9 PARAFFIN
21.517	13.75	211	C9 PARAFFIN
21.598	17.55	212	C9 PARAFFIN
21.755	96.89	213	ETHYLBENZENE
21.848	31.90	214	C9 PARAFFIN
21.985	244.73	215	m&p-XYLENE
22.175	54.70	367	C9 PARAFFIN
22.223	13.24	217	C9 PARAFFIN
22.337	42.42	218	C9 PARAFFIN
22.497	2014.91	220	C9 OLEFIN
22.620	90.26	222	o-XYLENE
22.732	44.75	224	C9 PARAFFIN
22.793	27.37	225	C9 PARAFFIN
22.862	17.94	226	C9 PARAFFIN
23.044	274.20	228	n-NONANE
23.173	69.78	229	C10 PARAFFIN
23.229	28.91	230	C10 PARAFFIN
23.315	53.54	231	C10 PARAFFIN
23.388	8.62	0	Uncalibrated
23.422	8.72	0	Uncalibrated
23.465	19.45	232	C10 PARAFFIN
23.544	15.55	233	C10 PARAFFIN
23.641	64.19	234	C10 PARAFFIN
23.730	12.05	235	C10 PARAFFIN
23.803	11.67	400	C10 PARAFFIN
23.895	37.57	237	C10 PARAFFIN
23.955	385.19	238	C10 PARAFFIN
24.021	69.91	239	C10 OLEFIN
24.173	35.21	241	C10 PARAFFIN
24.222	37.69	242	n-PROPYLBENZENE
24.314	14.72	243	C10 PARAFFIN
24.398	72.70	244	p-ETHYLTOLUENE
24.461	50.15	245	m-ETHYLTOLUENE
24.590	49.85	246	C9 AROMATIC
24.672	111.22	247	C10 PARAFFIN
24.862	69.50	249	o-ETHYLTOLUENE
24.910	12.43	0	Uncalibrated
25.037	40.74	0	Uncalibrated
25.072	25.81	251	C10 PARAFFIN
25.148	236.13	252	C10 OLEFIN
25.233	131.35	253	1,2,4-TRIMETHYLBENZENE
25.329	30.66	254	C9 AROMATIC
25.414	84.99	255	C10 PARAFFIN
25.532	100.34	256	n-DECANE
25.603	17.08	257	C9 AROMATIC
25.672	24.21	258	C9 AROMATIC
25.795	12.13	259	C9 AROMATIC
25.867	363.50	408	C9 AROMATIC
25.924	77.71	260	1,2,3-TRIMETHYLBENZENE
25.972	50.72	261	C11 PARAFFIN
26.115	62.59	263	C11 PARAFFIN

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Peak Identification Report

Retention Time	Concentration	CAL#	Compound Name
26.225	79.03	264	C10 AROMATIC
26.285	23.93	0	Uncalibrated
26.405	88.55	265	C10 AROMATIC
26.546	209.39	266	C10 AROMATIC
26.684	37.02	401	C10 AROMATIC
26.722	45.78	268	C10 AROMATIC
26.849	72.21	270	C10 AROMATIC
26.963	34.26	272	C10 AROMATIC
27.022	144.63	273	C11 PARAFFIN
27.150	338.81	373	C10 AROMATIC
27.375	45.47	277	C10 AROMATIC
27.465	121.89	278	C10 AROMATIC
27.554	28.82	356	C10 AROMATIC
27.609	48.82	279	C11 PARAFFIN
27.690	22.38	0	Uncalibrated
27.715	13.27	280	C10 AROMATIC
27.766	32.96	281	C10 AROMATIC
27.822	114.92	282	1,2-DIMETHYL-3-ETHYLBENZENE
27.877	72.26	403	C10 AROMATIC
28.019	68.68	283	C10 AROMATIC
28.128	61.67	285	1,2,3,5-TETRAMETHYLBENZENE
28.211	82.01	286	C10 AROMATIC
28.372	52.03	288	C10 AROMATIC
28.470	61.63	374	C10 AROMATIC
28.630	59.02	290	C11 AROMATIC
28.744	70.92	292	C11 AROMATIC
28.874	59.93	293	C11 AROMATIC
28.935	32.13	294	C11 AROMATIC
29.048	1151.75	380	C11 AROMATIC
29.133	79.11	296	C11 AROMATIC
29.216	39.12	297	C11 AROMATIC
29.282	17.88	298	C11 AROMATIC
29.358	29.40	299	C11 AROMATIC
29.463	38.10	377	C11 AROMATIC
29.598	723.95	300	C11 AROMATIC
29.709	54.52	301	C11 AROMATIC
29.839	40.16	302	C11 AROMATIC
29.899	30.68	303	C11 AROMATIC
29.951	92.62	304	C12 PARAFFIN
30.087	20.75	305	C11 AROMATIC
30.168	8.68	306	C11 AROMATIC
30.283	58.21	416	C11 AROMATIC
30.381	25.04	309	C11 AROMATIC
30.454	13.68	359	C11 AROMATIC
30.599	9.08	310	C11 AROMATIC
30.660	9.16	360	C11 AROMATIC
30.777	25.16	311	C11 AROMATIC
30.875	10.62	313	C11 AROMATIC
30.914	9.73	314	C12 AROMATIC
30.995	13.74	361	C12 AROMATIC
31.065	1.81	0	Uncalibrated

GGC STUDY 7/15/85 GGC12

Peak Identification Report

Retention Time	Concentration	CAL#	Compound Name
31.110	3.01	315	C12 AROMATIC
31.309	17.42	318	C12 AROMATIC
31.451	4.48	319	C12 AROMATIC
31.505	9.31	320	C12 AROMATIC
31.583	26.27	0	Uncalibrated
31.677	8.02	322	C12 AROMATIC
31.797	3.53	362	C12 AROMATIC
31.929	47.69	363	C12 AROMATIC
32.096	18.92	325	C12 AROMATIC
32.258	5.25	326	C12 AROMATIC
32.342	3.89	0	Uncalibrated
32.378	4.96	327	C12 AROMATIC
32.487	4.19	404	C12 AROMATIC
32.677	48.92	330	C12 AROMATIC
32.917	29.52	0	Uncalibrated
32.967	12.12	333	C12 AROMATIC
33.067	16.48	334	C12 AROMATIC
33.155	20.65	336	C12 AROMATIC
33.227	9.24	0	Uncalibrated
33.297	14.20	410	C12 AROMATIC
33.392	19.26	381	C12 AROMATIC
33.448	32.39	337	C12 AROMATIC
33.574	7.16	0	Uncalibrated
33.800	93.27	338	C12 AROMATIC
33.922	5.60	339	C12 AROMATIC
34.015	27.66	0	Uncalibrated
34.100	4.40	0	Uncalibrated
34.290	15.38	0	Uncalibrated
34.360	9.02	411	C12 AROMATIC
34.438	3.35	390	C12 AROMATIC
34.544	5.91	0	Uncalibrated
34.638	1.99	405	C12 AROMATIC
34.704	1.31	0	Uncalibrated
34.775	2.24	0	Uncalibrated
34.847	7.49	0	Uncalibrated
35.191	1.26	0	Uncalibrated
35.297	0.45	378	C12 AROMATIC
35.372	1.41	0	Uncalibrated
35.505	5.63	0	Uncalibrated
35.582	1.42	0	Uncalibrated
35.643	2.10	0	Uncalibrated
35.705	4.62	0	Uncalibrated
35.925	0.94	406	C12 AROMATIC
36.182	0.47	340	C12 AROMATIC
36.633	0.32	0	Uncalibrated

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HP5880A GC Analysis Report

Retention Time	Concentration ppbcarbon	CAL#	Compound
1.740	0.29	0	Uncalibrated
1.801	2.09	102	ETHYLENE
1.922	1.51	0	Uncalibrated
2.005	33.66	101	ETHANE
2.779	1.66	104	PROPENE
3.072	31.60	105	PROPANE
3.387	1.52	382	C3 PARAFFIN
4.560	5.66	383	C3 PARAFFIN
5.085	7.55	110	ISOBUTANE
6.172	1.54	113	2-METHYL PROPYLENE
6.452	26.40	115	n-BUTANE
6.912	0.57	116	t-2-BUTENE
7.237	0.32	384	C4 PARAFFIN
7.417	0.36	117	c-2-BUTENE
7.780	0.10	0	Uncalibrated
9.366	26.57	119	ISOPENTANE
9.736	1.55	393	C5 OLEFIN
9.973	1.47	121	1-PENTENE
10.065	1.21	122	C5 OLEFIN
10.245	2.35	123	2-METHYL-1-BUTENE
10.300	32.90	124	n-PENTANE
10.710	0.84	126	t-2-PENTENE
10.978	0.36	413	C5 OLEFIN
11.130	.4.65	128	C5 OLEFIN
11.517	1.24	0	Uncalibrated
11.599	1.05	131	C6 PARAFFIN
11.670	2.81	132	C6 PARAFFIN
11.957	0.98	395	C5 OLEFIN
12.127	0.24	134	C6 OLEFIN
12.277	0.34	396	C5 OLEFIN
12.353	0.31	135	C6 OLEFIN
12.460	7.19	0	Uncalibrated
12.577	3.73	385	C6 PARAFFIN
12.740	23.55	138	CYCLOPENTANE
12.920	11.87	139	2,3-DIMETHYLBUTANE
13.135	26.28	141	2-METHYLPENTANE
13.323	3.95	407	C6 PARAFFIN
13.457	0.18	144	C6 OLEFIN
13.611	24.50	146	C6 OLEFIN
13.703	0.74	344	C6 OLEFIN
13.767	0.82	147	C6 OLEFIN
13.847	0.68	0	Uncalibrated
13.941	0.42	143	n-HEXANE
14.036	0.22	150	C7 OLEFIN
14.304	0.39	152	C7 OLEFIN
14.462	25.91	154	C7 OLEFINN
14.530	1.34	0	Uncalibrated
14.639	2.16	155	C7 OLEFIN
14.738	5.22	0	Uncalibrated
14.791	10.33	156	METHYLCYCLOPENTANE
15.110	0.24	158	C7 PARAFFIN

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10/31/85

HP5880A GC Analysis Report

Retention Time	Concentration ppbcarbon	CAL#	Compound
15.250	26.02	159	C7 OLEFIN
15.451	0.65	160	C7 OLEFIN
15.550	7.74	161	C7 PARAFFIN
15.587	23.80	162	BENZENE
15.886	8.53	164	CYCLOHEXANE
15.930	4.04	0	Uncalibrated
16.011	2.36	165	C7 OLEFIN
16.168	13.20	166	2-METHYLHEXANE
16.366	5.40	168	C7 PARAFFIN
16.458	5.42	169	C7 OLEFIN
16.547	14.47	170	3-METHYLHEXANE
16.704	3.73	171	C7 PARAFFIN
16.953	15.42	173	2.[illegible]4-TRIMETHYLPENTANE
17.107	0.08	348	C7 OLEFIN
17.271	15.79	174	C8 OLEFIN
17.611	20.01	177	C8 OLEFIN
17.705	3.71	178	C8 OLEFIN
17.981	4.11	179	METHYLCYCLOHEXANE
18.051	2.11	366	C8 PARAFFIN
18.250	4.26	351	C8 OLEFIN
18.344	0.18	180	C8 PARAFFIN
18.476	7.56	181	C8 PARAFFIN
18.562	1.59	182	C8 PARAFFIN
18.697	54.13	397	C8 PARAFFIN
18.879	2.07	0	Uncalibrated
18.942	1.78	184	2,3,4-TRIMETHYLPENTANE
19.046	7.04	185	TOLUENE
19.169	0.89	388	C8 PARAFFIN
19.281	5.79	188	C8 PARAFFIN
19.415	14.00	189	C8 PARAFFIN
19.637	1.89	191	C8 PARAFFIN
19.713	1.76	0	Uncalibrated
19.817	3.97	192	C8 PARAFFIN
20.002	4.54	193	C8 PARAFFIN
20.061	9.00	0	Uncalibrated
20.107	5.66	194	C8 PARAFFIN
20.205	1.78	353	C8 PARAFFIN
20.277	0.65	195	C8 PARAFFIN
20.410	0.86	197	C8 PARAFFIN
20.481	0.21	198	n-OCTANE
20.610	1.05	200	C9 PARAFFIN
20.717	5.68	354	C9 OLEFIN
20.945	5.53	389	C9 PARAFFIN
21.046	4.04	202	C9 PARAFFIN
21.142	1.71	203	C9 OLEFIN
21.200	8.63	204	C9 PARAFFIN
21.287	1.18	0	Uncalibrated
21.375	1.67	205	C9 PARAFFIN
21.436	0.81	207	C9 PARAFFIN
21.537	18.08	208	C9 PARAFFIN
21.636	2.43	209	C9 PARAFFIN

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HP5880A GC Analysis Report

Retention Time	Concentration ppbcarbon	CAL#	Compound
21.777	44.18	211	C9 PARAFFIN
21.943	4.04	212	C9 PARAFFIN
21.996	3.37	213	ETHYLBENZENE
22.079	1.39	0	Uncalibrated
22.144	4.32	214	C9 PARAFFIN
22.288	593.07	215	m&p-XYLENE
22.336	8.47	0	Uncalibrated
22.429	15.76	216	C9 PARAFFIN
22.498	2.22	367	C9 PARAFFIN
22.612	6.07	219	C9 PARAFFIN
22.685	1.50	0	Uncalibrated
22.766	1.19	220	C9 OLEFIN
22.885	8.73	222	o-XYLENE
23.063	263.55	224	C9 PARAFFIN
23.284	40.98	227	C9 PARAFFIN
23.484	13.08	229	C10 PARAFFIN
23.579	3.96	230	C10 PARAFFIN
23.755	2.57	0	Uncalibrated
23.816	124.26	232	C10 PARAFFIN
24.045	1.31	235	C10 PARAFFIN
24.093	3.70	400	C10 PARAFFIN
24.190	0.40	236	C10 PARAFFIN
24.276	7.79	238	C10 PARAFFIN
24.336	3.80	239	C10 OLEFIN
24.376	2.69	0	Uncalibrated
24.473	5.21	240	C10 OLEFIN
24.532	4.06	241	C10 PARAFFIN
24.587	5.59	242	n-PROPYLBENZENE
24.716	8.65	0	Uncalibrated
24.752	6.34	244	p-ETHYLTOLUENE
24.925	2.28	246	C9 AROMATIC
24.978	2.83	247	C10 PARAFFIN
25.041	81.84	248	C10 PARAFFIN
25.127	22.49	0	Uncalibrated
25.224	2.99	249	o-ETHYLTOLUENE
25.350	16.29	250	C9 AROMATIC
25.443	10.81	251	C10 PARAFFIN
25.512	1.64	252	C10 OLEFIN
25.577	2.56	253	1,2,4-TRIMETHYLBENZENE
25.701	1.33	254	C9 AROMATIC
25.871	52.37	256	n-DECANE
26.037	9.14	258	C9 AROMATIC
26.147	8.52	259	C9 AROMATIC
26.202	1.77	408	C9 AROMATIC
26.312	9.14	260	1,2,3-TRIMETHYLBENZENE
26.446	1.77	262	C11 PARAFFIN
26.500	31.06	263	C11 PARAFFIN
26.610	9.59	264	C10 AROMATIC
26.652	5.17	0	Uncalibrated
26.724	0.43	0	Uncalibrated
26.777	1.49	265	C10 AROMATIC

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Retention Time	Concentration ppbcarbon	CAL#	Compound
26.831	1.40	0	Uncalibrated
26.904	1.97	266	C10 AROMATIC
26.984	8.23	401	C10 AROMATIC
27.080	2.13	268	C10 AROMATIC
27.133	4.50	0	Uncalibrated
27.180	3.88	269	C10 AROMATIC
27.260	0.85	271	C11 PARAFFIN
27.314	5.61	272	C10 AROMATIC
27.397	5.54	273	C11 PARAFFIN
27.474	13.78	0	Uncalibrated
27.545	2.16	274	C11 PARAFFIN
27.663	0.47	0	Uncalibrated
27.713	0.68	402	C10 AROMATIC
27.771	9.39	277	C10 AROMATIC
28.017	0.62	279	C11 PARAFFIN
28.079	7.96	280	C10 AROMATIC
28.158	7.97	281	C10 AROMATIC
28.318	3.20	283	C10 AROMATIC
28.433	3.13	284	1,2,4,5-TETRAMETHYLBENZENE
28.586	6.01	286	C10 AROMATIC
28.673	4.31	287	C11 PARAFFIN
28.825	3.47	0	Uncalibrated
28.888	4.60	374	C10 AROMATIC
29.023	84.39	290	C11 AROMATIC
29.182	3.43	292	C11 AROMATIC
29.340	1.95	294	C11 AROMATIC
29.405	1.51	370	C10 AROMATIC
29.543	195.79	296	C11 AROMATIC
29.655	3.80	298	C11 AROMATIC
29.865	1.18	377	C11 AROMATIC
29.934	6.69	300	C11 AROMATIC
30.063	0.65	301	C11 AROMATIC
30.279	4.02	302	C11 AROMATIC
30.446	0.69	0	Uncalibrated
30.557	0.25	305	C11 AROMATIC
30.644	1.21	307	C11 AROMATIC
30.746	0.90	358	C11 AROMATIC
30.871	0.72	359	C11 AROMATIC
30.990	0.81	409	C11 AROMATIC
31.036	0.26	310	C11 AROMATIC
31.140	0.21	311	C11 AROMATIC
31.227	0.27	312	C12 PARAFFIN
31.307	0.77	314	C12 AROMATIC
32.799	2.87	327	C12 AROMATIC
35.798	0.94	378	C12 AROMATIC
38.642	0.28	0	Uncalibrated
*** Total ***	2581.22		

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Retention Time	Concentration ppbcarbon	CAL#	Compound
1.907	2.02	102	ETHYLENE
1.947	1.20	103	ACETYLENE
2.015	21.20	101	ETHANE
3.001	1.60	104	PROPENE
3.113	44.78	105	PROPANE
3.221	1.36	0	Uncalibrated
3.932	0.29	375	C4 OLEFIN
4.040	0.35	108	OLEFIN
4.383	0.60	383	C3 PARAFFIN
4.848	1.11	0	Uncalibrated
5.101	9.33	110	ISOBUTANE
6.139	5.04	113	2-METHYL PROPYLENE
6.447	16.94	115	n-BUTANE
6.923	0.66	116	t-2-BUTENE
7.249	0.59	384	C4 PARAFFIN
7.487	0.50	117	c-2-BUTENE
9.300	7.02	119	ISOPENTANE
9.720	23.22	395	C5 OLEFIN
9.988	0.20	121	1-PENTENE
10.094	0.25	394	C5 OLEFIN
10.255	1.03	123	2-METHYL-1-BUTENE
10.392	11.31	124	n-PENTANE
10.727	3.46	126	t-2-PENTENE
11.084	25.49	128	C5 OLEFIN
11.382	3.09	0	Uncalibrated
11.527	2.10	132	C6 PARAFFIN
11.608	4.27	133	2.2-DIMETHYLBUTANE
11.950	1.08	134	C6 OLEFIN
12.060	0.22	396	C5 OLEFIN
12.284	2.19	0	Uncalibrated
12.366	0.23	385	C6 PARAFFIN
12.463	1.51	137	C6 OLEFIN
12.582	0.80	138	CYCLOPENTANE
12.745	5.61	139	2.3-DIMETHYLBUTANE
12.897	23.36	141	2-METHYLPENTANE
13.060	3.14	407	C6 PARAFFIN
13.134	14.65	369	C6 PARAFFIN
13.326	2.64	145	3-METHYLPENTANE
13.680	4.91	147	C6 OLEFIN
13.855	2.35	148	n-HEXANE
14.087	0.46	150	C7 OLEFIN
14.293	1.82	152	C7 OLEFIN
14.542	8.07	155	C7 OLEFIN
14.721	0.29	156	METHYLCYCLOPENTANE
14.815	11.09	386	C7 PARAFFIN
14.943	0.88	157	2,4-DIMETHYLPENTANE
15.180	0.39	159	C7 OLEFIN
15.331	10.39	415	C7 OLEFIN
15.621	51.85	162	BENZENE
15.974	1.67	165	C7 OLEFIN
16.025	1.86	0	Uncalibrated

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Retention Time	Concentration ppbcarbon	CAL#	Compound
16.088	1.03	346	C7 OLEFIN
16.254	5.46	167	2.3-DIMETHYLPENTANE
16.449	1.60	170	3-METHYLHEXANE
16.539	1.34	347	C7 PARAFFIN
16.590	8.19	0	Uncalibrated
16.688	0.85	171	C7 PARAFFIN
16.786	5.71	172	C7 PARAFFIN
17.035	2.23	345	C7 OLEFIN
17.341	35.80	176	C8 PARAFFIN
17.670	4.78	0	Uncalibrated
17.783	1.41	179	METHYLCYCLOHEXANE
18.060	0.88	351	C9 OLEFIN
18.135	0.42	180	C8 PARAFFIN
18.328	1.13	0	Uncalibrated
18.407	0.67	397	C8 PARAFFIN
18.537	4.83	183	C8 PARAFFIN
18.647	0.59	184	2.3,4-TRIMETHYLPENTANE
18.772	11.62	185	TOLUENE
18.838	0.55	0	Uncalibrated
18.900	0.13	338	C8 PARAFFIN
19.020	0.48	188	C8 PARAFFIN
19.120	1.48	189	C8 PARAFFIN
19.234	0.85	352	C8 PARAFFIN
19.355	1.31	191	C8 PARAFFIN
19.488	8.72	192	C8 PARAFFIN
19.737	1.19	0	Uncalibrated
19.787	0.56	194	C8 PARAFFIN
19.847	0.30	353	C8 PARAFFIN
19.892	0.88	195	C8 PARAFFIN
20.076	4.16	197	C8 PARAFFIN
20.127	0.94	198	n-OCTANE
20.227	0.77	200	C9 PARAFFIN
20.329	0.64	354	C9 OLEFIN
20.477	0.36	201	C9 PARAFFIN
20.538	0.37	389	C9 PARAFFIN
20.675	3.23	202	C9 PARAFFIN
20.779	28.68	203	C9 OLEFIN
21.105	0.53	208	C9 PARAFFIN
21.161	0.07	209	C9 PARAFFIN
21.258	1.81	210	C9 PARAFFIN
21.337	0.19	211	C9 PARAFFIN
21.433	0.52	212	C9 PARAFFIN
21.493	0.95	0	Uncalibrated
21.592	9.60	213	ETHYLBENZENE
21.700	1.67	214	C9 PARAFFIN
21.829	14.46	215	m&p-XYLENE
21.977	2.41	216	C9 PARAFFIN
22.041	4.48	367	C9 PARAFFIN
22.126	1.36	217	C9 PARAFFIN
22.202	1.40	218	C9 PARAFFIN
22.348	1215.24	221	C9 PARAFFIN

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PROJECT NMOC85 - SAMPLE GGCN2

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Retention Time	Concentration ppbcarbon	CAL#	Compound
22.478	9.25	222	o-XYLENE
22.595	0.64	224	C9 PARAFFIN
22.734	0.21	226	C9 PARAFFIN
22.807	0.26	227	C9 PARAFFIN
22.887	1.81	228	n-NONANE
22.926	1.11	0	Uncalibrated
23.172	55.62	231	C10 PARAFFIN
23.347	29.71	233	C10 PARAFFIN
23.527	3.01	235	C10 PARAFFIN
23.648	0.25	236	C10 PARAFFIN
23.853	259.72	239	C10 OLEFIN
24.015	0.61	241	C10 PARAFFIN
24.129	4.10	243	C10 PARAFFIN
24.309	7.19	245	m-ETHYLTOLUENE
24.372	4.15	246	C9 AROMATIC
24.505	3.59	248	C10 PARAFFIN
24.604	1.67	0	Uncalibrated
24.767	10.58	249	o-ETHYLTOLUENE
25.069	117.30	253	1,2,4-TRIMETHYLBENZENE
25.153	17.30	254	C9 AROMATIC
25.368	30.66	255	n-DECANE
25.467	5.48	256	C9 AROMATIC
25.541	0.86	0	Uncalibrated
25.602	1.01	259	C9 AROMATIC
25.725	0.73	260	1,2,3-TRIMETHYLBENZENE
25.789	2.54	261	C11 PARAFFIN
25.867	53.90	262	C11 PARAFFIN
26.032	4.30	264	C10 AROMATIC
26.100	3.06	0	Uncalibrated
26.167	10.14	265	C10 AROMATIC
26.331	8.67	266	C10 AROMATIC
26.494	55.14	401	C10 AROMATIC
26.621	0.91	269	C10 AROMATIC
26.671	7.01	270	C10 AROMATIC
26.797	1.28	272	C10 AROMATIC
26.842	1.48	273	C11 PARAFFIN
26.916	3.43	0	Uncalibrated
26.972	15.32	274	C11 PARAFFIN
27.096	6.46	0	Uncalibrated
27.152	3.87	402	C10 AROMATIC
27.194	6.78	277	C10 AROMATIC
27.271	4.18	278	C10 AROMATIC
27.330	8.12	355	C11 OLEFIN
27.469	31.39	280	C10 AROMATIC
27.555	3.61	281	C10 AROMATIC
27.654	2.96	0	Uncalibrated
27.681	1.85	403	C10 AROMATIC
27.728	3.26	0	Uncalibrated
27.783	13.61	283	C10 AROMATIC
28.085	13.74	287	C11 PARAFFIN
28.169	11.11	288	C10 AROMATIC

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PROJECT NMOC85 - SAMPLE GGCN2

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Retention Time	Concentration ppbcarbon	CAL#	Compound
28.336	2.66	357	C10 AROMATIC
28.435	7.05	290	C11 AROMATIC
28.596	10.62	292	C11 AROMATIC
28.702	3.57	294	C11 AROMATIC
28.792	4.82	370	C10 AROMATIC
28.837	8.82	380	C11 AROMATIC
28.899	6.23	296	C11 AROMATIC
29.016	187.64	297	C11 AROMATIC
29.093	11.67	298	C11 AROMATIC
29.185	4.12	299	C11 AROMATIC
29.325	3.06	0	Uncalibrated
29.402	4.74	300	C11 AROMATIC
29.492	0.97	301	C11 AROMATIC
29.557	[illegible]	0	Uncalibrated
29.665	9.14	302	C11 AROMATIC
29.778	4.34	304	C12 PARAFFIN
29.808	2.57	0	Uncalibrated
29.849	2.72	305	C11 AROMATIC
29.932	8.12	306	C11 AROMATIC
30.064	1.05	416	C11 AROMATIC
30.207	0.07	309	C11 AROMATIC
30.234	3.11	0	Uncalibrated
30.385	0.91	310	C11 AROMATIC
30.443	1.30	360	C11 AROMATIC
30.585	0.45	0	Uncalibrated
30.639	1.16	312	C11 AROMATIC
30.750	0.99	361	C12 AROMATIC
30.868	1.47	315	C12 AROMATIC
30.985	0.76	316	C12 AROMATIC
31.178	0.25	318	C12 AROMATIC
31.303	4.80	320	C12 AROMATIC
31.925	6.09	325	C12 AROMATIC
32.322	0.50	329	C12 AROMATIC
32.684	20.49	333	C12 AROMATIC
32.910	8.67	336	C12 AROMATIC
33.085	1.26	410	C12 AROMATIC
33.150	0.48	381	C12 AROMATIC
33.228	0.65	337	C12 AROMATIC
33.307	0.59	0	Uncalibrated
33.403	3.20	0	Uncalibrated
33.477	2.55	338	C12 AROMATIC
33.748	4.46	339	C12 AROMATIC
33.839	12.08	0	Uncalibrated
34.005	0.23	0	Uncalibrated
34.088	2.60	411	C12 AROMATIC
34.307	5.81	0	Uncalibrated
34.381	1.47	405	C12 AROMATIC
34.425	3.14	0	Uncalibrated
34.747	1.69	0	Uncalibrated
34.829	1.39	0	Uncalibrated
35.033	0.28	378	C12 AROMATIC

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Retention  Concentration
     Time      ppbcarbon       CAL#  Compound

   35.495           0.72          0 Uncalibrated
   35.723           0.79        406 C12 AROMATIC
*** Total ***
                 3291.46
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Retention Time	Concentration ppbcarbon	CAL#	Compound
1.720	0.21	0	Uncalibrated
1.865	2.88	0	Uncalibrated
1.904	1.04	102	ETHYLENE
1.976	32.62	101	ETHANE
2.956	2.74	104	PROPENE
3.072	32.23	105	PROPANE
4.348	0.70	383	C3 PARAFFIN
5.071	7.53	110	ISOBUTANE
6.115	5.08	113	2-METHYL PROPYLENE
6.260	0.17	114	BUTENE-1
6.424	20.60	115	n-BUTANE
6.905	0.60	116	t-2-BUTENE
7.230	0.56	384	C4 PARAFFIN
7.469	0.59	117	c-2-BUTENE
9.368	25.32	119	ISOPENTANE
9.707	0.15	393	C5 OLEFIN
9.975	0.86	121	1-PENTENE
10.006	3.19	394	C5 OLEFIN
10.245	1.63	123	2-METHYL-1-BUTENE
10.381	35.01	124	n-PENTANE
10.711	0.73	126	t-2-PENTENE
10.920	0.40	127	C5 OLEFIN
11.083	0.08	128	C5 OLEFIN
11.132	1.44	129	c-2-PENTENE
11.508	1.68	132	C6 PARAFFIN
11.599	3.87	133	2,2-DIMETHYLBUTANE
11.873	0.13	0	Uncalibrated
11.953	0.24	134	C6 OLEFIN
12.122	0.20	396	C5 OLEFIN
12.343	0.32	385	C6 PARAFFIN
12.451	7.51	137	C6 OLEFIN
12.567	3.52	138	CYCLOPENTANE
12.728	24.89	140	C6 OLEFIN
12.865	45.67	141	2-METHYLPENTANE
13.030	4.57	407	C6 PARAFFIN
13.119	24.87	0	Uncalibrated
13.303	3.57	145	3-METHYLPENTANE
13.455	0.60	376	C6 OLEFIN
13.669	23.89	147	C6 OLEFIN
13.858	0.24	0	Uncalibrated
13.940	0.45	148	n-HEXANE
14.030	0.26	149	C7 PARAFFIN
14.167	0.16	151	C7 OLEFIN
14.371	0.40	153	C7 OLEFIN
14.525	26.68	154	C7 OLEFINN
14.707	1.71	155	C7 OLEFIN
14.805	9.40	156	METHYLCYCLOPENTANE
14.937	1.86	371	C7 OLEFIN
15.167	0.31	159	C7 OLEFIN
15.319	23.73	0	Uncalibrated
15.435	1.35	160	C7 OLEFIN

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Retention Time	Concentration ppbcarbon	CAL#	Compound
15.515	0.75	364	C7 OLEFIN
15.602	103.00	162	BENZENE
15.959	9.35	165	C7 OLEFIN
16.004	5.18	0	Uncalibrated
16.083	2.20	346	C7 OLEFIN
16.241	13.24	167	2,3-DIMETHYLPENTANE
16.348	0.66	168	C7 PARAFFIN
16.439	5.65	170	3-METHYLHEXANE
16.529	5.27	347	C7 PARAFFIN
16.619	14.91	171	C7 PARAFFIN
16.777	3.88	172	C7 PARAFFIN
17.028	15.09	348	C7 OLEFIN
17.183	0.45	175	n-HEPTANE
17.341	22.11	176	C8 PARAFFIN
17.679	19.75	0	Uncalibrated
17.772	3.81	179	METHYLCYCLOHEXANE
17.907	0.16	366	C8 PARAFFIN
18.050	4.06	351	C8 OLEFIN
18.124	2.12	180	C8 PARAFFIN
18.318	3.99	182	C8 PARAFFIN
18.545	6.82	183	C8 PARAFFIN
18.634	1.00	184	2,3,4-TRIMETHYLPENTANE
18.763	51.22	185	TOLUENE
18.834	1.08	0	Uncalibrated
18.948	1.57	187	C8 PARAFFIN
19.007	1.83	188	C8 PARAFFIN
19.114	7.96	189	C8 PARAFFIN
19.161	1.46	190	C8 PARAFFIN
19.227	1.47	352	C8 PARAFFIN
19.347	5.46	191	C8 PARAFFIN
19.470	13.73	192	C8 PARAFFIN
19.727	2.38	193	C8 PARAFFIN
19.776	1.86	194	C8 PARAFFIN
19.841	1.27	353	C8 PARAFFIN
19.882	3.42	195	C8 PARAFFIN
20.062	3.22	197	C8 PARAFFIN
20.122	8.65	198	n-OCTANE
20.168	5.69	199	C9 PARAFFIN
20.265	1.70	200	C9 PARAFFIN
20.334	1.06	354	C9 OLEFIN
20.469	0.91	201	C9 PARAFFIN
20.641	0.31	202	C9 PARAFFIN
20.772	10.00	203	C9 OLEFIN
21.001	5.50	206	C9 PARAFFIN
21.100	4.28	208	C9 PARAFFIN
21.196	1.68	209	C9 PARAFFIN
21.254	8.69	210	C9 PARAFFIN
21.340	1.28	211	C9 PARAFFIN
21.425	3.57	212	C9 PARAFFIN
21.588	15.01	213	ETHYLBENZENE
21.687	3.50	214	C9 PARAFFIN

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Retention Time	Concentration ppbcarbon	CAL#	Compound
21.825	46.55	215	m&p-XYLENE
22.031	24.81	367	C9 PARAFFIN
22.120	1.94	217	C9 PARAFFIN
22.189	4.43	218	C9 PARAFFIN
22.335	326.21	220	C9 OLEFIN
22.398	7.73	221	C9 PARAFFIN
22.473	19.95	222	o-XYLENE
22.607	3.19	225	C9 PARAFFIN
22.657	2.70	0	Uncalibrated
22.727	1.41	226	C9 PARAFFIN
22.807	1.84	227	C9 PARAFFIN
22.923	7.74	223	n-NONANE
23.128	189.31	231	C10 PARAFFIN
23.527	19.17	235	C10 PARAFFIN
23.652	15.47	236	C10 PARAFFIN
23.734	2.35	237	C10 PARAFFIN
23.849	153.37	239	C10 OLEFIN
23.922	8.55	240	C10 OLEFIN
24.080	0.91	242	n-PROPYLBENZENE
24.126	3.51	243	C10 PARAFFIN
24.307	7.69	245	m-ETHYLTOLUENE
24.367	5.82	246	C9 AROMATIC
24.502	5.01	248	C10 PARAFFIN
24.567	3.51	0	Uncalibrated
24.608	6.29	0	Uncalibrated
24.750	5.44	0	Uncalibrated
24.776	6.62	250	C9 AROMATIC
24.943	2.76	252	C10 OLEFIN
25.065	62.25	253	1,2,4-TRIMETHYLBENZENE
25.153	19.25	254	C9 AROMATIC
25.240	3.82	255	C10 PARAFFIN
25.366	23.42	256	n-DECANE
25.467	10.67	258	C9 AROMATIC
25.533	1.43	0	Uncalibrated
25.602	2.29	259	C9 AROMATIC
25.722	1.06	260	1,2,3-TRIMETHYLBENZENE
25.831	127.59	261	C11 PARAFFIN
26.055	8.69	264	C10 AROMATIC
26.168	9.24	265	C10 AROMATIC
26.336	8.73	266	C10 AROMATIC
26.496	51.13	268	C10 AROMATIC
26.609	10.64	269	C10 AROMATIC
26.668	5.78	270	C10 AROMATIC
26.742	0.63	0	Uncalibrated
26.793	1.96	272	C10 AROMATIC
26.845	1.94	273	C11 PARAFFIN
26.923	2.41	373	C10 AROMATIC
27.003	8.10	275	C10 AROMATIC
27.096	1.82	402	C10 AROMATIC
27.195	28.51	277	C10 AROMATIC
27.328	8.73	355	C11 OLEFIN

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Retention Time	Concentration ppbcarbon	CAL#	Compound
27.403	4.05	279	C11 PARAFFIN
27.463	16.38	280	C10 AROMATIC
27.566	2.33	281	C10 AROMATIC
27.728	0.73	0	Uncalibrated
27.781	9.72	283	C10 AROMATIC
27.931	0.62	285	1,2,3,5-TETRAMETHYLBENZENE
28.081	7.45	287	C11 PARAFFIN
28.167	8.70	288	C10 AROMATIC
28.330	3.11	357	C10 AROMATIC
28.439	3.33	290	C11 AROMATIC
28.594	5.80	292	C11 AROMATIC
28.705	5.03	294	C11 AROMATIC
28.792	3.82	370	C10 AROMATIC
28.833	6.59	380	C11 AROMATIC
28.897	3.94	296	C11 AROMATIC
29.017	86.18	297	C11 AROMATIC
29.095	5.93	298	C11 AROMATIC
29.185	3.15	377	C11 AROMATIC
29.255	0.69	0	Uncalibrated
29.342	2.87	300	C11 AROMATIC
29.436	2.91	0	Uncalibrated
29.532	187.93	301	C11 AROMATIC
29.662	4.74	302	C11 AROMATIC
29.713	7.31	304	C12 PARAFFIN
29.807	2.93	0	Uncalibrated
29.866	2.72	305	C11 AROMATIC
29.927	8.14	306	C11 AROMATIC
30.062	1.41	416	C11 AROMATIC
30.147	0.41	309	C11 AROMATIC
30.269	4.89	359	C11 AROMATIC
30.448	1.01	360	C11 AROMATIC
30.590	0.23	0	Uncalibrated
30.635	0.68	313	C11 AROMATIC
30.748	1.05	361	C12 AROMATIC
30.867	0.67	315	C12 AROMATIC
30.985	0.76	316	C12 AROMATIC
31.208	0.23	319	C12 AROMATIC
31.301	1.48	320	C12 AROMATIC
31.597	0.48	362	C12 AROMATIC
31.921	7.11	325	C12 AROMATIC
32.220	0.82	404	C12 AROMATIC
32.317	1.35	329	C12 AROMATIC
32.374	0.11	330	C12 AROMATIC
32.513	0.62	331	C12 AROMATIC
32.614	0.28	332	C12 AROMATIC
32.695	0.86	333	C12 AROMATIC
32.817	1.20	334	C12 AROMATIC
32.903	8.15	336	C12 AROMATIC
32.954	2.66	0	Uncalibrated
33.053	4.35	410	C12 AROMATIC
33.139	4.72	381	C12 AROMATIC

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Retention  Concentration
     Time      ppbcarbon      CAL#  Compound


   33.222           2.85       337 C12 AROMATIC
   33.285           2.92         0 Uncalibrated
   33.388           5.32         0 Uncalibrated
   33.437           6.91         0 Uncalibrated
   33.561           1.92       338 C12 AROMATIC
   33.745           7.50       339 C12 AROMATIC
   33.797          29.90         0 Uncalibrated
   33.917           0.59         0 Uncalibrated
   34.006           2.97         0 Uncalibrated
   34.077           1.36       411 C12 AROMATIC
   34.134           1.12       390 C12 AROMATIC
   34.280           6.68         0 Uncalibrated
   34.353           4.38       405 C12 AROMATIC
   34.423           0.70         0 Uncalibrated
   34.522           0.47         0 Uncalibrated
   34.623           1.16         0 Uncalibrated
   34.700           1.17         0 Uncalibrated
   34.737           1.74         0 Uncalibrated
   34.825           5.07         0 Uncalibrated
   35.086           1.87       378 C12 AROMATIC
   35.195           1.02         0 Uncalibrated
   35.360           0.47         0 Uncalibrated
   35.490           2.14         0 Uncalibrated
   35.654           0.14       406 C12 AROMATIC
   35.775           0.52       340 C12 AROMATIC
*** Total ***
                 2821.78
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Retention Time	Concentration ppbcarbon	CAL#	Compound
1.733	0.23	0	Uncalibrated
1.870	2.04	0	Uncalibrated
1.915	1.26	0	Uncalibrated
1.980	18.47	0	Uncalibrated
2.981	1.53	104	PROPENE
3.080	19.92	105	PROPANE
3.277	2.61	382	C3 PARAFFIN
4.573	0.34	0	Uncalibrated
5.008	4.99	110	ISOBUTANE
6.107	0.13	113	2-METHYL PROPYLENE
6.447	12.81	115	n-BUTANE
6.930	0.76	116	t-2-BUTENE
7.257	0.65	0	Uncalibrated
7.493	0.55	117	c-2-BUTENE
9.397	6.97	119	ISOPENTANE
9.744	1.51	393	C5 OLEFIN
9.830	1.11	0	Uncalibrated
10.119	1.87	394	C5 OLEFIN
10.272	8.67	123	2-METHYL-1-BUTENE
10.416	6.30	124	n-PENTANE
10.726	1.68	126	t-2-PENTENE
10.844	0.86	413	C5 OLEFIN
11.157	7.76	129	c-2-PENTENE
11.498	2.43	131	C6 PARAFFIN
11.572	0.16	132	C6 PARAFFIN
11.691	0.27	133	2,2-DIMETHYLBUTANE
12.044	0.58	0	Uncalibrated
12.603	1.39	138	CYCLOPENTANE
12.743	0.59	139	2,3-DIMETHYLBUTANE
12.868	0.93	140	C6 OLEFIN
12.937	3.94	141	2-METHYLPENTANE
13.127	16.11	407	C6 PARAFFIN
13.271	5.77	369	C6 PARAFFIN
13.415	9.95	145	3-METHYLPENTANE
13.667	0.84	344	C6 OLEFIN
13.837	0.26	147	C6 OLEFIN
14.038	4.37	148	n-HEXANE
14.872	7.24	156	METHYLCYCLOPENTANE
15.064	0.23	157	2,4-DIMETHYLPENTANE
15.123	14.82	158	C7 PARAFFIN
15.290	1.14	159	C7 OLEFIN
15.506	0.69	160	C7 OLEFIN
15.661	12.17	162	BENZENE
15.790	0.29	387	C7 OLEFIN
15.879	0.10	163	3,3-DIMETHYLPENTANE
15.941	113.02	164	CYCLOHEXANE
16.300	2.38	166	2-METHYLHEXANE
16.350	3.17	167	2,3-DIMETHYLPENTANE
16.408	1.00	168	C7 PARAFFIN
16.577	4.78	170	3-METHYLHEXANE
16.668	0.61	347	C7 PARAFFIN

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Retention Time	Concentration ppbcarbon	CAL#	Compound
16.762	2.47	171	C7 PARAFFIN
16.849	2.23	365	C7 PARAFFIN
16.936	7.21	172	C7 PARAFFIN
17.097	6.77	348	C7 OLEFIN
17.340	4.60	175	n-HEPTANE
17.644	17.42	177	C8 OLEFIN
17.797	0.16	178	C8 OLEFIN
17.964	8.59	179	METHYLCYCLOHEXANE
18.056	2.28	366	C8 PARAFFIN
18.157	16.48	0	Uncalibrated
18.724	1.70	180	C8 PARAFFIN
18.397	1.07	181	C8 PARAFFIN
18.584	2.09	182	C8 PARAFFIN
18.801	4.09	183	C8 PARAFFIN
18.871	1.37	184	2,3,4-TRIMETHYLPENTANE
19.013	7.84	185	TOLUENE
19.072	0.64	0	Uncalibrated
19.191	[illegible]	187	C8 PARAFFIN
19.246	0.88	188	C8 PARAFFIN
19.349	4.12	189	C8 PARAFFIN
19.450	1.80	352	C8 PARAFFIN
19.574	2.19	191	C8 PARAFFIN
19.677	9.65	192	C8 PARAFFIN
19.940	1.84	193	C8 PARAFFIN
19.987	1.27	194	C8 PARAFFIN
20.088	4.07	195	C8 PARAFFIN
20.264	2.85	197	C8 PARAFFIN
20.319	3.65	198	n-OCTANE
20.404	0.36	199	C9 PARAFFIN
20.459	0.42	200	C9 PARAFFIN
20.524	0.31	354	C9 OLEFIN
20.656	0.66	201	C9 PARAFFIN
20.714	0.72	389	C9 PARAFFIN
20.831	0.37	202	C9 PARAFFIN
20.941	46.36	203	C9 OLEFIN
21.164	3.77	206	C9 PARAFFIN
21.212	0.58	207	C9 PARAFFIN
21.265	3.00	208	C9 PARAFFIN
21.350	0.91	209	C9 PARAFFIN
21.414	8.07	210	C9 PARAFFIN
21.500	0.91	211	C9 PARAFFIN
21.580	1.38	212	C9 PARAFFIN
21.738	7.48	213	ETHYLBENZENE
21.832	3.03	214	C9 PARAFFIN
21.967	20.00	215	m&p-XYLENE
22.165	30.10	367	C9 PARAFFIN
22.247	4.15	217	C9 PARAFFIN
22.316	3.92	218	C9 PARAFFIN
22.464	682.84	220	C9 OLEFIN
22.598	10.38	222	o-XYLENE
22.717	5.02	224	C9 PARAFFIN

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Retention Time	Concentration ppbcarbon	CAL#	Compound
22.777	2.19	225	C9 PARAFFIN
22.846	1.72	226	C9 PARAFFIN
22.924	2.31	227	C9 PARAFFIN
23.030	9.07	228	n-NONANE
23.124	17.24	0	Uncalibrated
23.153	19.77	229	C10 PARAFFIN
23.296	11.57	231	C10 PARAFFIN
23.442	9.20	232	C10 PARAFFIN
23.522	4.21	233	C10 PARAFFIN
23.625	10.20	234	C10 PARAFFIN
23.746	3.29	400	C10 PARAFFIN
23.793	2.87	0	Uncalibrated
23.882	4.33	237	C10 PARAFFIN
23.944	171.74	238	C10 PARAFFIN
24.164	3.75	241	C10 PARAFFIN
24.210	6.44	242	n-PROPYLBENZENE
24.300	1.73	243	C10 PARAFFIN
24.397	9.63	244	p-ETHYLTOLUENE
24.445	7.36	245	m-ETHYLTOLUENE
24.580	5.67	246	C9 AROMATIC
24.671	12.75	248	C10 PARAFFIN
24.822	15.76	249	o-ETHYLTOLUENE
24.997	2.03	0	Uncalibrated
25.018	4.63	0	Uncalibrated
25.071	3.37	251	C10 PARAFFIN
25.137	54.87	252	C10 OLEFIN
25.220	22.40	253	1.2.4-TRIMETHYLBENZENE
25.314	5.83	254	C9 AROMATIC
25.411	31.24	255	C10 PARAFFIN
25.521	13.99	256	n-DECANE
25.592	2.24	257	C9 AROMATIC
25.663	3.14	258	C9 AROMATIC
25.785	1.88	259	C9 AROMATIC
25.894	56.44	260	1.2.3-TRIMETHYLBENZENE
26.105	9.07	263	C11 PARAFFIN
26.271	7.45	264	C10 AROMATIC
26.272	2.45	0	Uncalibrated
26.386	8.87	265	C10 AROMATIC
26.447	1.71	0	Uncalibrated
26.549	56.86	267	C10 AROMATIC
26.665	6.28	401	C10 AROMATIC
26.714	5.35	268	C10 AROMATIC
26.838	2.75	270	C10 AROMATIC
26.886	2.14	271	C11 PARAFFIN
26.960	2.83	272	C10 AROMATIC
27.041	8.68	273	C11 PARAFFIN
27.187	11.86	275	C10 AROMATIC
27.224	8.08	276	1.2-DIMETHYL-4-ETHYLBENZENE
27.365	3.57	277	C10 AROMATIC
27.444	4.72	278	C10 AROMATIC
27.503	6.69	355	C11 OLEFIN

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Retention Time	Concentration ppbcarbon	CAL#	Compound
27.597	2.79	279	C11 PARAFFIN
27.660	0.33	280	C10 AROMATIC
27.760	1.21	281	C10 AROMATIC
27.812	15.40	282	1.2-DIMETHYL-3-ETHYLBENZENE
27.962	0.69	283	C10 AROMATIC
28.118	8.41	285	1,2,3,5-TETRAMETHYLBENZENE
28.200	12.37	286	C10 AROMATIC
28.360	6.93	288	C10 AROMATIC
28.463	4.53	374	C10 AROMATIC
28.507	2.14	357	C10 AROMATIC
28.664	23.09	291	C11 AROMATIC
28.735	9.29	292	C11 AROMATIC
28.820	6.83	0	Uncalibrated
28.864	9.60	293	C11 AROMATIC
28.927	8.35	294	C11 AROMATIC
29.035	74.22	380	C11 AROMATIC
29.117	10.09	296	C11 AROMATIC
29.208	9.22	297	C11 AROMATIC
29.360	4.46	299	C11 AROMATIC
29.457	6.38	377	C11 AROMATIC
29.581	285.60	300	C11 AROMATIC
29.690	14.95	301	C11 AROMATIC
29.835	5.66	302	C11 AROMATIC
29.890	6.15	303	C11 AROMATIC
29.943	18.01	304	C12 PARAFFIN
30.080	3.33	305	C11 AROMATIC
30.170	0.88	306	C11 AROMATIC
30.276	9.62	416	C11 AROMATIC
30.466	1.91	359	C11 AROMATIC
30.598	2.52	310	C11 AROMATIC
30.648	2.03	360	C11 AROMATIC
30.765	4.12	312	C12 PARAFFIN
30.878	2.59	0	Uncalibrated
30.907	1.82	314	C12 AROMATIC
30.992	2.98	361	C12 AROMATIC
31.057	0.52	315	C12 AROMATIC
31.213	2.93	316	C12 AROMATIC
31.305	4.79	318	C12 AROMATIC
31.400	0.17	319	C12 AROMATIC
31.453	0.08	0	Uncalibrated
31.510	0.28	320	C12 AROMATIC
31.603	1.59	321	C12 AROMATIC
31.693	0.65	322	C12 AROMATIC
31.790	0.37	362	C12 AROMATIC
31.935	21.23	323	C12 AROMATIC
32.190	0.20	326	C12 AROMATIC
32.296	8.96	327	C12 AROMATIC
32.500	0.26	404	C12 AROMATIC
32.637	0.51	330	C12 AROMATIC
32.710	0.99	331	C12 AROMATIC
32.818	2.19	332	C12 AROMATIC

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Retention  Concentration
     Time      ppbcarbon      CAL#  Compound

   32.917           7.38       333 C12 AROMATIC
   32.974           2.54         0 Uncalibrated
   33.082           3.81       334 C12 AROMATIC
   33.137           1.60         0 Uncalibrated
   33.173           2.15       336 C12 AROMATIC
   33.235           2.75         0 Uncalibrated
   33.316           1.92       410 C12 AROMATIC
   33.408           4.77       381 C12 AROMATIC
   33.477           3.74       337 C12 AROMATIC
   33.573           1.47         0 Uncalibrated
   33.752           5.52         0 Uncalibrated
   33.818           4.93       338 C12 AROMATIC
   33.962           0.30       335 C12 AROMATIC
   34.007           0.45         0 Uncalibrated
   34.098           1.67         0 Uncalibrated
   34.440           0.26       390 C12 AROMATIC
   34.539           0.54       405 C12 AROMATIC
   34.941           0.78         0 Uncalibrated
   35.060           3.11         0 Uncalibrated
   35.150           0.79       378 C12 AROMATIC
   38.510           0.04         0 Uncalibrated
   38.689           0.06         0 Uncalibrated
*** Total ***
                 2625.04
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Retention Time	Concentration ppbcarbon	CAL#	Compound
17.337	2.03	175	n-HEPTANE
17.647	6.18	177	C8 OLEFIN
17.962	4.36	179	METHYLCYCLOHEXANE
18.057	1.23	366	C8 PARAFFIN
18.247	0.08	351	C8 OLEFIN
18.322	0.79	180	C8 PARAFFIN
18.397	0.33	181	C8 PARAFFIN
18.582	1.06	182	C8 PARAFFIN
18.796	3.36	183	C8 PARAFFIN
18.983	0.49	184	2,3,4-TRIMETHYLPENTANE
19.011	8.46	185	TOLUENE
19.077	0.96	0	Uncalibrated
19.181	0.07	187	C8 PARAFFIN
19.247	0.41	188	C8 PARAFFIN
19.347	1.27	189	C8 PARAFFIN
19.460	0.76	352	C8 PARAFFIN
19.570	0.83	191	C8 PARAFFIN
19.704	8.73	192	C8 PARAFFIN
19.920	0.38	193	C8 PARAFFIN
19.967	0.51	194	C8 PARAFFIN
20.085	1.55	195	C8 PARAFFIN
20.270	1.83	197	C8 PARAFFIN
20.316	0.68	198	n-OCTANE
20.401	0.17	199	C9 PARAFFIN
20.456	0.12	200	C9 PARAFFIN
20.511	0.34	354	C9 OLEFIN
20.655	0.15	201	C9 PARAFFIN
20.727	0.11	389	C9 PARAFFIN
20 943	20.58	203	C9 OLEFIN
21.143	1.19	206	C9 PARAFFIN
21.217	0.20	207	C9 PARAFFIN
21.266	0.76	208	C9 PARAFFIN
21.415	1.98	210	C9 PARAFFIN
21.582	0.97	212	C9 PARAFFIN
21.739	4.65	213	ETHYLBENZENE
21.870	0.91	399	C9 PARAFFIN
21.970	9.44	215	m&p-XYLENE
22.170	15.27	367	C9 PARAFFIN
22.253	1.95	217	C9 PARAFFIN
22.315	0.60	218	C9 PARAFFIN
22.472	1052.38	220	C9 OLEFIN
22.602	10.15	222	o-XYLENE
22.723	1.90	224	C9 PARAFFIN
22.933	0.26	227	C9 PARAFFIN
23.028	2.24	228	n-NONANE
23.190	16.65	229	C10 PARAFFIN
23.283	6.41	231	C10 PARAFFIN
23.448	4.82	232	C10 PARAFFIN
23.530	0.40	233	C10 PARAFFIN
23.629	0.51	234	C10 PARAFFIN
23.750	3.08	400	C10 PARAFFIN

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Retention Time	Concentration ppbcarbon	CAL#	Compound
1.771	0.20	0	Uncalibrated
1.900	1.87	102	ETHYLENE
1.944	1.14	0	Uncalibrated
2.008	21.20	0	Uncalibrated
3.006	1.54	0	Uncalibrated
3.106	30.51	105	PROPANE
3.304	1.85	382	C3 PARAFFIN
4.601	0.14	0	Uncalibrated
5.107	6.55	110	ISOBUTANE
6.115	3.72	113	2-METHYL PROPYLENE
6.457	14.80	115	n-BUTANE
7.804	1.64	0	Uncalibrated
9.402	8.03	117	ISOPENTANE
9 755	1.63	0	Uncalibrated
10.128	3.89	394	C5 OLEFIN
10.280	3.07	123	2-METHYL-1-BUTENE
10.415	7.51	124	n-PENTANE
10.740	1.97	126	t-2-PENTENE
11.165	2.96	129	c-2-PENTENE
11.576	0.74	132	C6 PARAFFIN
11.685	3.11	133	2,2-DIMETHYLBUTANE
12.046	0.53	0	Uncalibrated
12.490	0.26	137	C6 OLEFIN
12.593	1.31	138	CYCLOPENTANE
12.733	0.65	139	2,3-DIMETHYLBUTANE
12.930	4.61	141	2-METHYLPENTANE
13.120	21.00	407	C6 PARAFFIN
13.335	2.99	144	C6 OLEFIN
13.407	7.80	145	3-METHYLPENTANE
13.661	0.74	344	C6 OLEFIN
13.825	0.45	147	C6 OLEFIN
14.031	3.54	148	n-HEXANE
14.862	4.87	156	METHYLCYCLOPENTANE
14.899	2.74	386	C7 PARAFFIN
15.054	0.24	157	2,4-DIMETHYLPENTANE
15.172	5.45	158	C7 PARAFFIN
15.274	1.05	159	C7 OLEFIN
15.514	0.31	160	C7 OLEFIN
15.656	5.44	162	BENZENE
15.783	0.28	307	C7 OLEFIN
15.875	0.58	163	3,3-DIMETHYLPENTANE
15.972	34.71	164	CYCLOHEXANE
16.297	1.45	166	2-METHYLHEXANE
16.343	1.25	167	2,3-DIMETHYLPENTANE
16.402	1.31	168	C7 PARAFFIN
16.573	5.92	170	3-METHYLHEXANE
16.756	1.61	171	C7 PARAFFIN
16.844	1.29	365	C7 PARAFFIN
16.897	2.30	172	C7 PARAFFIN
16.930	2.14	0	Uncalibrated
17.098	1.42	348	C7 OLEFIN

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HP5880A GC Analysis Report

Retention Time	Concentration ppbcarbon	CAL# Compound
23.945	145.62	238 C10 PARAFFIN
24.010	17.60	239 C10 OLEFIN
24.215	2.80	242 n-PROPYLBENZENE
24.390	5.78	244 p-ETHYLTOLUENE
24.447	3.44	245 m-ETHYLTOLUENE
24.582	2.90	246 C9 AROMATIC
24.685	2.15	248 C10 PARAFFIN
24.821	15.15	249 o-ETHYLTOLUENE
25.074	2.52	251 C10 PARAFFIN
25.161	82.16	252 C10 OLEFIN
25.225	11.10	253 1,2,4-TRIMETHYLBENZENE
25.292	4.98	254 C9 AROMATIC
25.419	19.02	255 C10 PARAFFIN
25.527	4.30	256 n-DECANE
25.604	0.76	257 C9 AROMATIC
25.661	1.43	258 C9 AROMATIC
25.777	0.45	259 C9 AROMATIC
25.895	78.14	260 1,2,3-TRIMETHYLBENZENE
26.107	3.83	263 C11 PARAFFIN
26.222	9.97	264 C10 AROMATIC
26.385	7.62	265 C10 AROMATIC
26.558	41.86	267 C10 AROMATIC
26.669	3.82	401 C10 AROMATIC
26.719	4.83	268 C10 AROMATIC
26.842	1.22	270 C10 AROMATIC
26.887	0.80	271 C11 PARAFFIN
27.014	16.39	273 C11 PARAFFIN
27.135	6.65	373 C10 AROMATIC
27.231	8.40	276 1,2-DIMETHYL-4-ETHYLBENZENE
27.313	1.67	402 C10 AROMATIC
27.370	4.05	277 C10 AROMATIC
27.461	8.69	278 C10 AROMATIC
27.504	6.81	355 C11 OLEFIN
27.600	2.49	279 C11 PARAFFIN
27.677	2.23	280 C10 AROMATIC
27.760	4.11	281 C10 AROMATIC
27.817	6.66	282 1,2-DIMETHYL-3-ETHYLBENZENE
27.880	3.20	403 C10 AROMATIC
27.937	2.69	283 C10 AROMATIC
28.041	0.80	284 1,2,4,5-TETRAMETHYLBENZENE
28.122	4.99	285 1,2,3,5-TETRAMETHYLBENZENE
28.203	7.54	286 C10 AROMATIC
28.367	1.65	288 C10 AROMATIC
28.465	2.80	374 C10 AROMATIC
28.515	1.65	357 C10 AROMATIC
28.632	6.80	290 C11 AROMATIC
28.733	2.43	292 C11 AROMATIC
28.869	6.87	293 C11 AROMATIC
28.929	3.64	294 C11 AROMATIC
29.040	45.96	380 C11 AROMATIC
29.126	7.03	296 C11 AROMATIC

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Retention Time	Concentration ppbcarbon	CAL# Compound
29.211	2.19	297 C11 AROMATIC
29.357	1.35	299 C11 AROMATIC
29.426	2.46	377 C11 AROMATIC
29.582	202.53	300 C11 AROMATIC
29.695	4.18	301 C11 AROMATIC
29.766	0.26	0 Uncalibrated
29.850	0.65	302 C11 AROMATIC
29.895	1.02	303 C11 AROMATIC
29.948	7.00	304 C12 PARAFFIN
30.085	0.68	305 C11 AROMATIC
30.201	3.57	416 C11 AROMATIC
30.457	0.51	359 C11 AROMATIC
30.606	0.71	310 C11 AROMATIC
30.654	0.39	360 C11 AROMATIC
30.775	0.39	312 C12 PARAFFIN
30.877	0.79	313 C11 AROMATIC
30.910	0.59	314 C12 AROMATIC
30.995	0.86	361 C12 AROMATIC
31.168	0.64	315 C12 AROMATIC
31.310	2.60	318 C12 AROMATIC
31.580	0.50	321 C12 AROMATIC
31.633	0.35	322 C12 AROMATIC
31.938	9.51	323 C12 AROMATIC
32.193	0.03	326 C12 AROMATIC
32.328	2.41	327 C12 AROMATIC
32.523	0.71	329 C12 AROMATIC
32.637	0.59	330 C12 AROMATIC
32.710	0.88	331 C12 AROMATIC
32.824	0.26	332 C12 AROMATIC
32.924	4.39	333 C12 AROMATIC
32.975	1.46	0 Uncalibrated
33.089	1.99	334 C12 AROMATIC
33.142	2.65	336 C12 AROMATIC
33.240	2.33	0 Uncalibrated
33.316	1.24	410 C12 AROMATIC
33.410	7.79	381 C12 AROMATIC
33.567	1.60	337 C12 AROMATIC
33.758	5.63	0 Uncalibrated
33.823	12.47	338 C12 AROMATIC
33.972	0.13	339 C12 AROMATIC
34.027	1.48	0 Uncalibrated
34.092	1.35	0 Uncalibrated
34.317	4.60	411 C12 AROMATIC
34.404	0.77	0 Uncalibrated
34.436	0.36	390 C12 AROMATIC
34.541	0.61	405 C12 AROMATIC
34.756	1.33	0 Uncalibrated
34.830	3.70	0 Uncalibrated
35.372	0.45	378 C12 AROMATIC
35.502	2.07	0 Uncalibrated
35.621	0.18	0 Uncalibrated

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Retention  Concentration
     Time      ppbcarbon        CAL#  Compound

   35.704           0.28           0 Uncalibrated
   36.177           0.17         340 C12 AROMATIC
   37.214           0.34           0 Uncalibrated
*** Total ***
                 2309.36
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Retention Time	Concentration ppbcarbon	CAL#	Compound
1.885	2.07	0	Uncalibrated
1.922	1.26	0	Uncalibrated
1.991	18.02	0	Uncalibrated
2.934	1.37	104	PROPENE
3.094	19.96	105	PROPANE
3.281	1.98	382	C3 PARAFFIN
4.377	0.58	383	C3 PARAFFIN
4.487	0.16	0	Uncalibrated
5.097	4.95	110	ISOBUTANE
6.145	3.18	0	Uncalibrated
6.452	12.35	115	n-BUTANE
6.937	0.48	116	t-2-BUTENE
7.260	0.56	0	Uncalibrated
7.500	0.30	117	c-2-BUTENE
9.402	6.81	119	ISOPENTANE
9.743	1.68	393	C5 OLEFIN
9.853	2.17	0	Uncalibrated
10.010	1.22	121	1-PENTENE
10.120	3.57	122	C5 OLEFIN
10.280	0.88	123	2-METHYL-1-BUTENE
10.417	6.20	124	n-PENTANE
11.120	0.07	0	Uncalibrated
11.171	0.55	128	C5 OLEFIN
11.575	1.18	131	C6 PARAFFIN
11.674	2.85	0	Uncalibrated
12.016	0.39	134	C6 OLEFIN
12.500	1.29	385	C6 PARAFFIN
12.635	0.61	137	C6 OLEFIN
12.833	5.04	139	2,3-DIMETHYLBUTANE
12.999	0.89	0	Uncalibrated
13.053	10.47	141	2-METHYLPENTANE
13.318	9.27	369	C6 PARAFFIN
13.565	0.96	146	C6 OLEFIN
13.732	0.47	0	Uncalibrated
13.777	0.75	147	C6 OLEFIN
13.938	3.72	148	n-HEXANE
14.773	5.51	156	METHYLCYCLOPENTANE
14.820	1.40	386	C7 PARAFFIN
14.964	0.30	157	2,4-DIMETHYLPENTANE
15.080	10.29	158	C7 PARAFFIN
15.185	1.16	159	C7 OLEFIN
15.478	0.20	364	C7 OLEFIN
15.564	37.85	162	BENZENE
15.888	26.90	164	CYCLOHEXANE
16.211	1.78	166	2-METHYLHEXANE
16.252	1.10	167	2,3-DIMETHYLPENTANE
16.320	1.70	168	C7 PARAFFIN
16.492	4.87	170	3-METHYLHEXANE
16.677	2.25	171	C7 PARAFFIN
16.766	2.25	365	C7 PARAFFIN
16.855	5.59	172	C7 PARAFFIN

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Retention Time	Concentration ppbcarbon	CAL#	Compound
16.910	0.90	173	2,2,4-TRIMETHYLPENTANE
17.017	2.31	0	Uncalibrated
17.091	0.62	348	C7 OLEFIN
17.262	4.55	175	n-HEPTANE
17.565	25.87	177	C8 OLEFIN
17.896	8.40	179	METHYLCYCLOHEXANE
17.990	1.94	366	C8 PARAFFIN
18.257	1.73	180	C8 PARAFFIN
18.331	0.70	181	C8 PARAFFIN
18.520	2.01	182	C8 PARAFFIN
18.605	0.08	377	C8 PARAFFIN
18.740	5.31	183	C8 PARAFFIN
18.831	1.20	184	2,3,4-TRIMETHYLPENTANE
18.954	0.95	185	TOLUENE
19.014	0.50	0	Uncalibrated
19.131	0.23	187	C8 PARAFFIN
19.190	0.83	188	C8 PARAFFIN
19.295	4.20	189	C8 PARAFFIN
19.344	1.87	190	C8 PARAFFIN
19.410	3.04	352	C8 PARAFFIN
19.523	3.87	191	C8 PARAFFIN
19.652	11.96	192	C8 PARAFFIN
19.884	1.00	193	C8 PARAFFIN
19.939	0.95	194	C8 PARAFFIN
20.042	2.31	195	C8 PARAFFIN
20.222	3.86	197	C8 PARAFFIN
20.277	4.62	198	n-OCTANE
20.362	3.19	199	C9 PARAFFIN
20.417	1.01	200	C9 PARAFFIN
20.478	0.55	354	C9 OLEFIN
20.614	0.62	201	C9 PARAFFIN
20.683	0.17	389	C9 PARAFFIN
20.783	0.23	202	C9 PARAFFIN
20.907	37.42	203	C9 OLEFIN
21.132	3.66	206	C9 PARAFFIN
21.180	0.58	207	C9 PARAFFIN
21.231	2.91	208	C9 PARAFFIN
21.317	0.96	209	C9 PARAFFIN
21.382	7.54	210	C9 PARAFFIN
21.470	0.96	211	C9 PARAFFIN
21.550	1.71	212	C9 PARAFFIN
21.710	7.72	213	ETHYLBENZENE
21.807	3.00	214	C9 PARAFFIN
21.941	20.61	215	m&p-XYLENE
22.100	2.24	216	C9 PARAFFIN
22.150	3.42	367	C9 PARAFFIN
22.224	1.25	217	C9 PARAFFIN
22.294	3.23	218	C9 PARAFFIN
22.442	818.39	220	C9 OLEFIN
22.577	9.88	222	o-XYLENE
22.711	4.40	224	C9 PARAFFIN

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Retention Time	Concentration ppbcarbon	CAL#	Compound
22.755	1.78	225	C9 PARAFFIN
22.824	0.96	226	C9 PARAFFIN
22.904	0.71	227	C9 PARAFFIN
23.095	267.93	229	C10 PARAFFIN
23.607	10.37	234	C10 PARAFFIN
23.925	174.10	238	C10 PARAFFIN
24.150	2.19	241	C10 PARAFFIN
24.197	3.79	242	n-PROPYLBENZENE
24.291	0.27	243	C10 PARAFFIN
24.375	7.16	244	p-ETHYLTOLUENE
24.435	3.19	245	m-ETHYLTOLUENE
24.476	2.62	0	Uncalibrated
24.567	4.31	246	C9 AROMATIC
24.657	9.81	248	C10 PARAFFIN
24.810	12.99	249	o-ETHYLTOLUENE
25.010	3.06	251	C10 PARAFFIN
25.125	130.97	252	C10 OLEFIN
25.211	23.33	253	1,2,4-TRIMETHYLBENZENE
25.306	3.49	254	C9 AROMATIC
25.406	55.19	255	C10 PARAFFIN
25.515	13.16	256	n-DECANE
25.584	2.00	257	C9 AROMATIC
25.654	2.70	258	C9 AROMATIC
25.775	1.73	408	C9 AROMATIC
25.845	3.25	260	1,2,3-TRIMETHYLBENZENE
25.921	50.44	261	C11 PARAFFIN
26.100	9.81	263	C11 PARAFFIN
26.214	11.95	264	C10 AROMATIC
26.377	12.39	265	C10 AROMATIC
26.539	44.13	267	C10 AROMATIC
26.658	7.55	268	C10 AROMATIC
26.710	6.20	0	Uncalibrated
26.835	2.81	271	C11 PARAFFIN
26.877	1.37	0	Uncalibrated
26.957	2.12	273	C11 PARAFFIN
27.013	11.45	0	Uncalibrated
27.184	60.67	276	1,2-DIMETHYL-4-ETHYLBENZENE
27.362	7.47	278	C10 AROMATIC
27.444	11.74	355	C11 OLEFIN
27.504	18.33	356	C10 AROMATIC
27.595	3.90	279	C11 PARAFFIN
27.755	1.59	282	1,2-DIMETHYL-3-ETHYLBENZENE
27.810	15.32	403	C10 AROMATIC
28.113	14.38	286	C10 AROMATIC
28.199	11.61	287	C11 PARAFFIN
28.359	5.55	288	C10 AROMATIC
28.462	4.25	357	C10 AROMATIC
28.505	2.13	379	C11 AROMATIC
28.622	9.71	291	C11 AROMATIC
28.733	8.70	292	C11 AROMATIC
28.819	4.77	293	C11 AROMATIC

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Retention Time	Concentration ppbcarbon	CAL#	Compound
28.964	9.35	294	C11 AROMATIC
28.925	6.71	370	C10 AROMATIC
29.040	115.98	295	C11 AROMATIC
29.120	13.19	297	C11 AROMATIC
29.208	5.57	298	C11 AROMATIC
29.276	1.26	299	C11 AROMATIC
29.364	4.62	377	C11 AROMATIC
29.453	4.95	0	Uncalibrated
29.580	279.66	300	C11 AROMATIC
29.689	10.67	301	C11 AROMATIC
29.755	4.72	0	Uncalibrated
29.830	5.10	303	C11 AROMATIC
29.890	5.97	304	C12 PARAFFIN
29.947	17.71	0	Uncalibrated
30.092	3.07	306	C11 AROMATIC
30.163	0.86	307	C11 AROMATIC
30.203	10.79	358	C11 AROMATIC
30.469	1.89	409	C11 AROMATIC
30.570	0.80	310	C11 AROMATIC
30.604	0.85	360	C11 AROMATIC
30.660	1.83	311	C11 AROMATIC
30.764	3.60	313	C11 AROMATIC
30.841	0.59	314	C12 AROMATIC
31.007	2.31	315	C12 AROMATIC
31.052	0.32	0	Uncalibrated
31.143	1.08	316	C12 AROMATIC
31.225	2.13	317	C12 AROMATIC
31.312	5.46	319	C12 AROMATIC
31.403	0.85	320	C12 AROMATIC
31.457	0.78	0	Uncalibrated
31.520	1.40	0	Uncalibrated
31.614	4.45	322	C12 AROMATIC
31.699	3.28	362	C12 AROMATIC
31.790	1.75	0	Uncalibrated
31.868	1.33	323	C12 AROMATIC
31.936	3.24	324	C12 AROMATIC
32.111	0.21	326	C12 AROMATIC
32.285	0.16	327	C12 AROMATIC
35.863	0.19	406	C12 AROMATIC
*** Total ***	2892.77		

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Retention Time	Concentration ppbcarbon	CAL#	Compound
16.736	7.73	171	C7 PARAFFIN
16.825	7.26	365	C7 PARAFFIN
16.913	15.61	172	C7 PARAFFIN
17.076	3.95	348	C7 OLEFIN
17.318	14.30	175	n-HEPTANE
17.466	0.25	176	C8 PARAFFIN
17.641	10.88	177	C8 OLEFIN
17.945	20.30	179	METHYLCYCLOHEXANE
18.039	4.32	366	C8 PARAFFIN
18.305	4.48	180	C8 PARAFFIN
18.377	1.50	181	C8 PARAFFIN
18.566	5.43	182	C8 PARAFFIN
18.786	9.01	183	C8 PARAFFIN
18.872	1.69	184	2,3,4-TRIMETHYLPENTANE
18.998	16.39	185	TOLUENE
19.175	0.99	187	C8 PARAFFIN
19.235	1.70	188	C8 PARAFFIN
19.335	9.47	189	C8 PARAFFIN
19.460	0.78	352	C8 PARAFFIN
19.561	4.64	191	C8 PARAFFIN
19.672	14.83	192	C8 PARAFFIN
19.709	3.04	193	C8 PARAFFIN
19.975	2.61	194	C8 PARAFFIN
20.076	6.00	195	C8 PARAFFIN
20.152	0.86	196	C8 PARAFFIN
20.251	5.79	197	C8 PARAFFIN
20.310	11.53	198	n-OCTANE
20.394	4.44	199	C9 PARAFFIN
20.450	2.30	200	C9 PARAFFIN
20.521	0.81	354	C9 OLEFIN
20.646	1.67	201	C9 PARAFFIN
20.813	0.75	202	C9 PARAFFIN
20.937	19.59	203	C9 OLEFIN
21.160	5.63	206	C9 PARAFFIN
21.207	1.24	207	C9 PARAFFIN
21.259	5.30	208	C9 PARAFFIN
21.343	1.79	209	C9 PARAFFIN
21.409	12.99	210	C9 PARAFFIN
21.495	1.65	211	C9 PARAFFIN
21.575	1.96	212	C9 PARAFFIN
21.733	11.35	213	ETHYLBENZENE
21.826	3.04	214	C9 PARAFFIN
21.962	28.32	215	m&p-XYLENE
22.122	3.89	216	C9 PARAFFIN
22.192	2.60	367	C9 PARAFFIN
22.315	6.19	219	C9 PARAFFIN
22.454	293.18	220	C9 OLEFIN
22.593	10.08	222	o-XYLENE
22.667	1.61	223	C9 PARAFFIN
22.734	4.55	224	C9 PARAFFIN
22.772	2.37	225	C9 PARAFFIN

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Retention Time	Concentration ppbcarbon	CAL#	Compound
1.613	2.66	0	Uncalibrated
1.915	5.23	0	Uncalibrated
2.017	186.09	0	Uncalibrated
2.976	0.90	104	PROPENE
3.080	135.51	105	PROPANE
4.370	0.46	383	C3 PARAFFIN
5.075	21.93	110	ISOBUTANE
6.132	4.33	0	Uncalibrated
6.435	49.41	115	n-BUTANE
6.927	1.02	116	t-2-BUTENE
7.247	0.53	0	Uncalibrated
7.487	0.47	117	c-2-BUTENE
9.386	25.86	119	ISOPENTANE
9.737	0.97	0	Uncalibrated
10.000	0.81	121	1-PENTENE
10.267	0.68	123	2-METHYL-1-BUTENE
10.400	28.10	18	
10.730	0.12	126	t-2-PENTENE
10.993	0.08	127	C5 OLEFIN
11.150	3.04	129	c-2-PENTENE
11.535	0.71	132	C6 PARAFFIN
11.611	0.86	133	2,2-DIMETHYLBUTANE
11.753	1.70	395	C5 OLEFIN
12.035	0.57	0	Uncalibrated
12.435	0.14	136	C6 PARAFFIN
12.568	5.52	138	CYCLOPENTANE
12.705	2.56	139	2,3-DIMETHYLBUTANE
12.900	12.76	141	2-METHYLPENTANE
13.139	6.87	407	C6 PARAFFIN
13.384	14.10	145	3-METHYLPENTANE
13.622	1.60	344	C6 OLEFIN
13.920	0.11	0	Uncalibrated
14.001	16.36	148	n-HEXANE
14.122	0.49	149	C7 PARAFFIN
14.181	0.54	150	C7 OLEFIN
14.256	0.50	151	C7 OLEFIN
14.350	0.19	152	C7 OLEFIN
14.691	0.19	155	C7 OLEFIN
14.837	20.56	156	METHYLCYCLOPENTANE
14.949	0.56	371	C7 OLEFIN
15.028	1.32	157	2,4-DIMETHYLPENTANE
15.127	1.00	158	C7 PARAFFIN
15.22[illegible]	0.53	159	C7 OLEFIN
15.631	16.99	162	BENZENE
15.828	0.25	163	3,3-DIMETHYLPENTANE
15.926	8.35	164	CYCLOHEXANE
16.002	26.28	165	C7 OLEFIN
16.274	4.92	166	2-METHYLHEXANE
16.312	2.92	167	2,3-DIMETHYLPENTANE
16.389	2.83	168	C7 PARAFFIN
16.547	7.87	170	3-METHYLHEXANE

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Retention Time	Concentration ppbcarbon	CAL#	Compound
22.840	1.80	226	C9 PARAFFIN
22.921	1.53	227	C9 PARAFFIN
23.037	6.70	228	n-NONANE
23.093	4.51	0	Uncalibrated
23.435	0.76	232	C10 PARAFFIN
23.622	5.46	234	C10 PARAFFIN
23.879	3.31	237	C10 PARAFFIN
23.941	90.98	238	C10 PARAFFIN
24.163	1.92	241	C10 PARAFFIN
24.210	3.28	242	n-PROPYLBENZENE
24.300	0.53	243	C10 PARAFFIN
24.387	6.63	244	p-ETHYLTOLUENE
24.447	4.90	245	m-ETHYLTOLUENE
24.578	3.97	246	C9 AROMATIC
24.675	10.73	248	C10 PARAFFIN
24.849	7.51	249	o-ETHYLTOLUENE
24.895	1.25	0	Uncalibrated
25.022	3.81	0	Uncalibrated
25.070	2.75	251	C10 PARAFFIN
25.137	37.01	252	C10 OLEFIN
25.220	13.37	253	1,2,4-TRIMETHYLBENZENE
25.314	3.30	254	C7 AROMATIC
25.414	11.95	255	C10 PARAFFIN
25.522	11.52	256	n-DECANE
25.589	1.77	257	C9 AROMATIC
25.662	2.50	258	C9 AROMATIC
25.785	1.87	259	C9 AROMATIC
25.912	50.75	260	1,2,3-TRIMETHYLBENZENE
26.104	10.37	263	C11 PARAFFIN
26.222	4.92	264	C10 AROMATIC
26.275	2.61	0	Uncalibrated
26.389	7.71	265	C10 AROMATIC
26.557	27.04	267	C10 AROMATIC
26.667	5.32	401	C10 AROMATIC
26.715	4.33	268	C10 AROMATIC
26.840	3.11	270	C10 AROMATIC
26.880	1.19	271	C11 PARAFFIN
26.958	1.82	272	C10 AROMATIC
27.045	4.93	273	C11 PARAFFIN
27.186	12.29	275	C10 AROMATIC
27.227	13.48	276	1,2-DIMETHYL-4-ETHYLBENZENE
27.365	4.48	277	C10 AROMATIC
27.440	3.26	278	C10 AROMATIC
27.504	8.15	355	C11 OLEFIN
27.599	2.16	279	C11 PARAFFIN
27.760	0.64	281	C10 AROMATIC
27.812	10.79	282	1,2-DIMETHYL-3-ETHYLBENZENE
27.969	0.77	283	C10 AROMATIC
28.055	0.69	284	1,2,4,5-TETRAMETHYLBENZENE
28.118	5.90	285	1,2,3,5-TETRAMETHYLBENZENE
28.202	7.05	286	C10 AROMATIC

Page No. 4 PROJECT NMOC85 - SAMPLE GGCN7
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HP5880A GC Analysis Report

Retention Time	Concentration ppbcarbon	CAL#	Compound
28.360	4.20	288	C10 AROMATIC
28.464	2.51	374	C10 AROMATIC
28.509	1.38	357	C10 AROMATIC
28.620	5.74	290	C11 AROMATIC
28.735	6.05	292	C11 AROMATIC
28.865	7.36	293	C11 AROMATIC
28.927	3.17	294	C11 AROMATIC
29.040	40.87	380	C11 AROMATIC
29.122	4.05	295	C11 AROMATIC
29.209	3.11	297	C11 AROMATIC
29.283	0.20	298	C11 AROMATIC
29.356	1.52	299	C11 AROMATIC
29.453	1.35	377	C11 AROMATIC
29.578	145.21	300	C11 AROMATIC
29.688	4.38	301	C11 AROMATIC
29.720	4.43	0	Uncalibrated
29.828	2.81	302	C11 AROMATIC
29.890	3.96	303	C11 AROMATIC
29.943	10.80	304	C12 PARAFFIN
30.081	2.24	305	C11 AROMATIC
30.161	0.75	306	C11 AROMATIC
30.277	6.86	416	C11 AROMATIC
30.462	1.35	359	C11 AROMATIC
30.594	1.11	310	C11 AROMATIC
30.655	0.89	360	C11 AROMATIC
30.762	1.67	312	C12 PARAFFIN
30.907	0.22	314	C12 AROMATIC
30.994	1.41	361	C12 AROMATIC
31.140	0.19	316	C12 AROMATIC
31.213	0.86	0	Uncalibrated
31.302	2.62	318	C12 AROMATIC
31.401	0.10	319	C12 AROMATIC
31.514	0.16	320	C12 AROMATIC
31.607	1.09	321	C12 AROMATIC
31.686	0.15	322	C12 AROMATIC
31.790	0.27	362	C12 AROMATIC
31.931	4.58	323	C12 AROMATIC
32.237	0.16	326	C12 AROMATIC
32.327	0.73	327	C12 AROMATIC
32.628	0.98	330	C12 AROMATIC
32.707	0.65	331	C12 AROMATIC
32.915	5.69	333	C12 AROMATIC
32.966	2.60	0	Uncalibrated
33.067	3.50	334	C12 AROMATIC
33.158	4.02	336	C12 AROMATIC
33.230	1.93	0	Uncalibrated
33.298	2.69	410	C12 AROMATIC
33.401	4.01	381	C12 AROMATIC
33.465	2.08	337	C12 AROMATIC
33.751	6.34	0	Uncalibrated
33.811	13.38	338	C12 AROMATIC

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Page No.     5         PROJECT NMOC85 - SAMPLE GGCN7
10/31/85
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Retention  Concentration
     Time     ppbcarbon        CAL#  Compound


   33.920          1.33         339 C12 AROMATIC
   33.960          1.88           0 Uncalibrated
   34.020          3.29           0 Uncalibrated
   34.085          2.47           0 Uncalibrated
   34.296          4.26         411 C12 AROMATIC
   34.372          2.23           0 Uncalibrated
   34.430          0.93         390 C12 AROMATIC
   34.483          0.14           0 Uncalibrated
   34.633          0.66         405 C12 AROMATIC
   34.708          0.73           0 Uncalibrated
   34.749          0.82           0 Uncalibrated
   34.832          4.66           0 Uncalibrated
   35.017          0.33           0 Uncalibrated
   35.197          0.51         378 C12 AROMATIC
   35.307          0.23           0 Uncalibrated
   35.381          0.27           0 Uncalibrated
   35.497          0.90           0 Uncalibrated
   35.717          1.95         406 C12 AROMATIC
   36.067          0.24         340 C12 AROMATIC
*** Total ***
                2038.11
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Page No.      1              PROJECT GGC86 - SAMPLE GGC1
08/04/86
                               HP5880A GC Analysis Report

Retention  Concentration
   Time       ppbcarbon         CAL#  Compound


    1.550          3.40            0
    1.846          2.15            0
    1.951         30.11          103 ACETYLENE
    3.033         41.26          105 PROPANE
    5.000          6.79          110 ISOBUTANE
    6.012          2.54          113 2-METHYL PROPYLENE
    6.345         18.63          115 n-BUTANE
    6.840          0.16          116 t-2-BUTENE
    7.700          0.12            0
    9.273          8.05          119 ISOPENTANE
   10.013          1.96          394 C5 OLEFIN
   10.197          1.85          123 2-METHYL-1-BUTENE
   10.298          6.41          124 n-PENTANE
   10.500          0.15            0
   11.078          2.30          129 c-2-PENTENE
   11.444          0.35          132 C6 PARAFFIN
   11.920          0.87            0
   12.063          0.73          135 C6 OLEFIN
   12.438          0.80          138 CYCLOPENTANE
   12.809          2.25          141 2-METHYLPENTANE
   13.130         35.52          369 C6 PARAFFIN
   13.526          7.82          344 C6 OLEFIN
   13.743          1.60          147 C6 OLEFIN
   13.925          2.46          148 n-HEXANE
   14.710          2.61          156 METHYLCYCLOPENTANE
   15.014          0.83          158 C7 PARAFFIN
   15.272          6.65          415 C7 OLEFIN
   15.534          3.46          162 BENZENE
   15.786          1.19          164 CYCLOHEXANE
   16.047         43.51          346 C7 OLEFIN
   16.373          2.94          169 C7 OLEFIN
   16.452          2.30          170 3-METHYLHEXANE
   16.525          6.94          347 C7 PARAFFIN
   16.790          1.46          172 C7 PARAFFIN
   17.217          1.33          175 n-HEPTANE
   17.558         24.11          177 C8 OLEFIN
   17.816          1.55          179 METHYLCYCLOHEXANE
   18.727          2.24          184 2,3,4-TRIMETHYLPENTANE
   18.887          2.92          185 TOLUENE
   19.019          0.81          388 C8 PARAFFIN
   19.209          0.59          189 C8 PARAFFIN
   19.688          3.79          193 C8 PARAFFIN
   20.191          0.43          198 n-OCTANE
   20.284          1.74          199 C9 PARAFFIN
   20.651          0.94          289 C9 PARAFFIN
   20.837         23.34          203 C9 OLEFIN
   21.273          0.44          209 C9 PARAFFIN
   21.614          1.52          213 ETHYLBENZENE
   21.858          2.32          215 m&p-XYLENE
   22.128          0.50          217 C9 PARAFFIN
   22.221          0.34          218 C9 PARAFFIN
   22.462          5.69          222 o-XYLENE
   22.833          2.68          227 C9 PARAFFIN
   22.910          1.27          228 n-NONANE
   23.051         56.02          229 C10 PARAFFIN
   23.680          0.48          236 C10 PARAFFIN
   23.750          0.81          237 C10 PARAFFIN
   23.873          5.63          239 C10 OLEFIN
   24.354          0.63          245 m-ETHYLTOLUENE
   24.594          0.59          248 C10 PARAFFIN
   24.695          7.56          249 o-ETHYLTOLUENE
   25.015          5.22          252 C10 OLEFIN
   25.080         20.94          253 1,2,4-TRIMETHYLBENZENE
   25.295         11.43          255 C10 PARAFFIN
   25.857          2.15          261 C11 PARAFFIN
   25.970          1.35          263 C11 PARAFFIN
   26.057          1.66          264 C10 AROMATIC
   26.475         18.96          267 C10 AROMATIC
   27.401         14.99          356 C10 AROMATIC
   27.671          0.37          282 1,2-DIMETHYL-3-ETHYLBENZENE
   27.891          0.58          284 1,2,4,5-TETRAMETHYLBENZENE
   28.011          0.93          285 1,2,3,5-TETRAMETHYLBENZENE
   28.193          0.46          288 C10 AROMATIC
   28.695          4.16          293 C11 AROMATIC
   29.053          1.73          297 C11 AROMATIC
   29.223          0.39          299 C11 AROMATIC
   29.443          0.76          300 C11 AROMATIC
   29.812          0.30          304 C12 PARAFFIN
   31.940          0.39          325 C12 AROMATIC
*** Total ***
                 487.26
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PROJECT GGC86 - SAMPLE GGC2

08/04/86

HP5880A GC Analysis Report

Retention Time	Concentration ppbcarbon	CAL#	Compound
1.567	4.49	0	
1.877	100.24	0	
1.989	34.70	0	
2.935	56.63	104	PROPENE
3.040	59.21	105	PROPANE
5.002	9.07	110	ISOBUTANE
5.520	135.34	0	
6.030	71.73	0	
6.344	27.10	115	n-BUTANE
6.625	5.39	0	
6.674	1.62	0	
6.748	2.34	0	
7.381	2.76	117	c-2-BUTENE
7.677	0.66	0	
8.612	3.17	118	C4 OLEFIN
8.916	2.09	0	
9.272	18.99	119	ISOPENTANE
9.444	1240.40	412	C5 OLEFIN
9.697	2.49	0	
9.873	19.94	121	1-PENTENE
10.147	30.79	123	2-METHYL-1-BUTENE
10.285	20.95	124	n-PENTANE
10.435	0.71	125	ISOPRENE
10.543	6.76	0	
10.877	1.27	127	C5 OLEFIN
11.037	15.33	128	C5 OLEFIN
11.345	5.38	0	
11.552	17.50	133	2,2-DIMETHYLBUTANE
11.804	41.14	0	
12.063	4.64	396	C5 OLEFIN
12.157	0.64	135	C6 OLEFIN
12.237	9.47	0	
12.295	25.84	385	C6 PARAFFIN
12.440	7.43	137	C6 OLEFIN
12.579	41.25	138	CYCLOPENTANE
12.805	56.85	140	C6 OLEFIN
12.923	294.69	141	2-METHYLPENTANE
13.137	548.33	407	C6 PARAFFIN
13.359	15.29	145	3-METHYLPENTANE
13.484	33.22	146	C6 OLEFIN
13.664	11.78	147	C6 OLEFIN
13.806	19.06	0	
13.870	28.63	148	n-HEXANE
13.977	3.62	149	C7 PARAFFIN
14.053	11.74	150	C7 OLEFIN
14.118	7.34	151	C7 OLEFIN
14.224	4.19	152	C7 OLEFIN
14.352	1.17	153	C7 OLEFIN
14.433	10.25	154	C7 OLEFINN
14.555	1.13	155	C7 OLEFIN
14.707	31.00	386	C7 PARAFFIN
14.896	3.75	157	2,4-DIMETHYLPENTANE
14.992	22.28	0	
15.079	67.47	159	C7 OLEFIN
15.311	72.75	160	C7 OLEFIN
15.425	26.68	162	BENZENE
15.489	11.97	387	C7 OLEFIN
15.567	1.73	0	
15.610	2.86	163	3,3-DIMETHYLPENTANE
15.778	14.98	0	
15.827	81.26	165	C7 OLEFIN
15.999	19.76	0	
16.162	447.08	167	2,3-DIMETHYLPENTANE
16.312	13.22	169	C7 OLEFIN
16.404	275.64	347	C7 PARAFFIN
16.488	44.69	0	
16.593	13.66	171	C7 PARAFFIN
16.705	24.03	172	C7 PARAFFIN
16.769	16.30	0	
16.815	29.43	173	2,2,4-TRIMETHYLPENTANE
16.857	36.62	0	
17.070	3.28	174	C8 OLEFIN
17.166	47.52	175	n-HEPTANE
17.244	16.25	349	C8 OLEFIN
17.433	6.28	0	
17.491	10.57	177	C8 OLEFIN
17.573	4.16	178	C8 OLEFIN
17.725	12.25	0	
17.795	37.16	179	METHYLCYCLOHEXANE
17.872	42.95	366	C8 PARAFFIN
17.948	20.21	0	
18.060	10.99	351	C8 OLEFIN
18.152	14.89	180	C8 PARAFFIN
18.275	65.63	181	C8 PARAFFIN
18.418	8.84	182	C8 PARAFFIN
18.488	16.95	397	C8 PARAFFIN
18.610	169.24	183	C8 PARAFFIN

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Page No.      2          PROJECT GGC86 - SAMPLE GGC2
08/04/86
                           HP5880A GC Analysis Report

Retention  Concentration
     Time      ppbcarbon        CAL#  Compound

   18.875         180.60         185 TOLUENE
   19.027         124.58         186 C8 PARAFFIN
   19.186          58.04           0
   19.278         224.46         190 C8 PARAFFIN
   19.410          20.21         352 C8 PARAFFIN
   19.535         229.27         192 C8 PARAFFIN
   19.712          12.40           0
   19.829          53.36         193 C8 PARAFFIN
   19.923          14.92         194 C8 PARAFFIN
   20.099          14.46         196 C8 PARAFFIN
   20.160          23.05         197 C8 PARAFFIN
   20.250          10.33         198 n-OCTANE
   20.382          15.12           0
   20.444           7.18         200 C9 PARAFFIN
   20.498           7.82         354 C9 OLEFIN
   20.613          34.78         201 C9 PARAFFIN
   20.735         153.32         289 C9 PARAFFIN
   20.824          41.88         202 C9 PARAFFIN
   20.990          49.60         204 C9 PARAFFIN
   21.057          17.63         205 C9 PARAFFIN
   21.257         102.61         208 C9 PARAFFIN
   21.381           3.43         209 C9 PARAFFIN
   21.447          21.18         398 C9 PARAFFIN
   21.576          16.30         212 C9 PARAFFIN
   21.676          71.74           0
   21.739          53.62         213 ETHYLBENZENE
   21.808          48.73           0
   22.010         151.07         215 m&p-XYLENE
   22.090         395.44           0
   22.166          27.37         216 C9 PARAFFIN
   22.267          14.64         217 C9 PARAFFIN
   22.362         119.54         218 C9 PARAFFIN
   22.436          15.43         219 C9 PARAFFIN
   22.480          26.96         220 C9 OLEFIN
   22.573          52.51         221 C9 PARAFFIN
   22.668           7.33         222 o-XYLENE
   22.753           4.07         224 C9 PARAFFIN
   22.869          23.98         226 C9 PARAFFIN
   22.993          19.28         227 C9 PARAFFIN
   23.141          35.27           0
   23.228           8.97         229 C10 PARAFFIN
   23.305           8.36         231 C10 PARAFFIN
   23.418          32.38         232 C10 PARAFFIN
   23.579         100.89         233 C10 PARAFFIN
   23.639          17.39         234 C10 PARAFFIN
   23.726         121.42         235 C10 PARAFFIN
   23.792         555.91         400 C10 PARAFFIN
   23.930           4.80         237 C10 PARAFFIN
   24.047          61.03         239 C10 OLEFIN
   24.224          56.18         242 n-PROPYLBENZENE
   24.287          60.73         243 C10 PARAFFIN
   24.421          28.79         244 p-ETHYLTOLUENE
   24.471          19.45         245 m-ETHYLTOLUENE
   24.536          16.20           0
   24.583          28.17         246 C9 AROMATIC
   24.665         125.76         247 C10 PARAFFIN
   24.799          10.50           0
   24.857          10.98         249 o-ETHYLTOLUENE
   24.956          63.78         250 C9 AROMATIC
   25.059          46.48         251 C10 PARAFFIN
   25.139           9.44         252 C10 OLEFIN
   25.231          19.20         253 1,2,4-TRIMETHYLBENZENE
   25.361          19.86         254 C9 AROMATIC
   25.504           1.60         256 n-DECANE
   25.594          13.05         257 C9 AROMATIC
   25.707          40.22         258 C9 AROMATIC
   25.790          22.28         259 C9 AROMATIC
   25.927          36.32         260 1,2,3-TRIMETHYLBENZENE
   26.095          63.98         263 C11 PARAFFIN
   26.164           8.66           0
   26.226          55.23         264 C10 AROMATIC
   26.390         124.00         265 C10 AROMATIC
   26.553          22.78         267 C10 AROMATIC
   26.667          12.46         401 C10 AROMATIC
   26.772          10.85         269 C10 AROMATIC
   26.869          11.51         271 C11 PARAFFIN
   26.965           9.02         272 C10 AROMATIC
   27.061          43.64         273 C11 PARAFFIN
   27.188          11.82         275 C10 AROMATIC
   27.344          40.16         277 C10 AROMATIC
   27.410          20.16         278 C10 AROMATIC
   27.517           7.45         355 C11 OLEFIN
   27.647          17.28           0
   27.702           8.88         280 C10 AROMATIC
   27.809           3.33         282 1,2-DIMETHYL-3-ETHYLBENZENE
   27.880           1.76         403 C10 AROMATIC
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PROJECT GGC86 - SAMPLE GGC2

HP5880A GC Analysis Report

Retention Time	Concentration ppbcarbon	CAL#	Compound
27.948	3.20	283	C10 AROMATIC
28.046	33.57	284	1,2,4,5-TETRAMETHYLBENZENE
28.190	2.68	286	C10 AROMATIC
28.307	7.53	288	C10 AROMATIC
28.441	26.72	374	C10 AROMATIC
28.559	5.95	379	C11 AROMATIC
28.630	4.09	290	C11 AROMATIC
28.686	6.10	291	C11 AROMATIC
28.761	2.34	292	C11 AROMATIC
28.896	5.48	294	C11 AROMATIC
28.963	7.63	370	C10 AROMATIC
29.044	0.91	295	C11 AROMATIC
29.118	2.08	296	C11 AROMATIC
29.210	5.94	297	C11 AROMATIC
29.412	11.65	377	C11 AROMATIC
29.557	12.68	300	C11 AROMATIC
29.648	3.06	0	
29.715	2.71	301	C11 AROMATIC
29.781	11.72	302	C11 AROMATIC
29.909	6.73	304	C12 PARAFFIN
30.116	4.52	306	C11 AROMATIC
30.180	1.49	307	C11 AROMATIC
30.301	1.56	358	C11 AROMATIC
30.372	1.89	309	C11 AROMATIC
30.495	1.01	409	C11 AROMATIC
30.592	0.82	310	C11 AROMATIC
30.653	1.38	360	C11 AROMATIC
30.735	1.25	311	C11 AROMATIC
30.883	0.99	314	C12 AROMATIC
31.030	2.12	315	C12 AROMATIC
31.099	2.15	0	
31.232	0.89	317	C12 AROMATIC
31.315	3.31	318	C12 AROMATIC
31.577	7.26	321	C12 AROMATIC
31.705	1.41	414	C12 AROMATIC
31.776	6.58	362	C12 AROMATIC
32.177	0.58	326	C12 AROMATIC
32.555	0.55	329	C12 AROMATIC
32.759	1.34	331	C12 AROMATIC
32.950	0.81	333	C12 AROMATIC
33.047	1.69	334	C12 AROMATIC
33.453	0.93	337	C12 AROMATIC
33.737	1.26	338	C12 AROMATIC
34.800	0.43	0	
35.025	0.20	0	
35.580	0.50	0	
*** Total ***			
	9545.39		

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Page No.      1             PROJECT GGC86 - SAMPLE GGC3
08/04/86
                              HP5880A GC Analysis Report

Retention  Concentration
   Time       ppbcarbon         CAL#  Compound


     1.853          2.61            0
     1.975         22.83            0
     3.027         29.93          105 PROPANE
     4.317          0.62            0
     4.991          6.49          110 ISOBUTANE
     6.003          0.92          113 2-METHYL PROPYLENE
     6.339         20.00          115 n-BUTANE
     8.610          0.16          118 C4 OLEFIN
     9.267         16.61          119 ISOPENTANE
     9.886          0.48          121 1-PENTENE
     9.966          0.48          122 C5 OLEFIN
    10.152          0.50          123 2-METHYL-1-BUTENE
    10.279         18.16          124 n-PENTANE
    10.440          0.12          125 ISOPRENE
    10.611          1.12          126 t-2-PENTENE
    10.875          0.49          127 C5 OLEFIN
    11.035          2.08          129 c-2-PENTENE
    11.410          0.12          132 C6 PARAFFIN
    11.496          0.31          133 2,2-DIMETHYLBUTANE
    11.920          0.56          396 C5 OLEFIN
    12.060          0.46          135 C6 OLEFIN
    12.299          1.55          136 C6 PARAFFIN
    12.434          4.53          138 CYCLOPENTANE
    12.489          0.69            0
    12.572          2.41          139 2,3-DIMETHYLBUTANE
    12.654          0.26          140 C6 OLEFIN
    12.767         14.61          141 2-METHYLPENTANE
    12.847          0.57          142 C6 OLEFIN
    13.110          1.80          369 C6 PARAFFIN
    13.249         10.13          145 3-METHYLPENTANE
    13.486          6.23          344 C6 OLEFIN
    13.579          0.51            0
    13.675          0.36          147 C6 OLEFIN
    13.870         19.76          148 n-HEXANE
    13.970          0.85          149 C7 PARAFFIN
    14.052          1.13          150 C7 OLEFIN
    14.127          2.58          151 C7 OLEFIN
    14.215          1.11          152 C7 OLEFIN
    14.352          0.59          153 C7 OLEFIN
    14.561          1.08          155 C7 OLEFIN
    14.700         22.10          156 METHYLCYCLOPENTANE
    14.893          1.76          157 2,4-DIMETHYLPENTANE
    14.988          0.79          158 C7 PARAFFIN
    15.170          0.86            0
    15.491          7.97          162 BENZENE
    15.567          0.63          387 C7 OLEFIN
    15.784          9.76          164 CYCLOHEXANE
    16.002          1.18          346 C7 OLEFIN
    16.133          9.66          166 2-METHYLHEXANE
    16.168          5.42          167 2,3-DIMETHYLPENTANE
    16.245          2.60          168 C7 PARAFFIN
    16.312          2.44          169 C7 OLEFIN
    16.405         12.04          170 3-METHYLHEXANE
    16.492          3.22          347 C7 PARAFFIN
    16.593         10.45          171 C7 PARAFFIN
    16.680          9.39          365 C7 PARAFFIN
    16.768         18.13          172 C7 PARAFFIN
    16.819          7.48          173 2,2,4-TRIMETHYLPENTANE
    17.015          0.42          348 C7 OLEFIN
    17.175         30.92          175 n-HEPTANE
    17.330          1.59          176 C8 PARAFFIN
    17.485          2.36          177 C8 OLEFIN
    17.584          1.06          178 C8 OLEFIN
    17.797         30.15          179 METHYLCYCLOHEXANE
    17.891          4.34          366 C8 PARAFFIN
    18.157          8.10          180 C8 PARAFFIN
    18.234          3.40          181 C8 PARAFFIN
    18.418          7.13          182 C8 PARAFFIN
    18.639         13.38          183 C8 PARAFFIN
    18.727          5.89          184 2,3,4-TRIMETHYLPENTANE
    18.854         28.12          185 TOLUENE
    19.030          2.92          187 C8 PARAFFIN
    19.084          3.58          188 C8 PARAFFIN
    19.189         25.79          189 C8 PARAFFIN
    19.299          0.81          352 C8 PARAFFIN
    19.343          0.84            0
    19.414         10.36          191 C8 PARAFFIN
    19.519         16.84          192 C8 PARAFFIN
    19.575          6.41            0
    19.740          5.14          193 C8 PARAFFIN
    19.829          6.24          194 C8 PARAFFIN
    19.925         10.69          195 C8 PARAFFIN
    20.008          1.59          196 C8 PARAFFIN
    20.096          8.50          197 C8 PARAFFIN
    20.163         31.32          198 n-OCTANE
    20.245          6.09          199 C9 PARAFFIN
    20.295          5.47          200 C9 PARAFFIN
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PROJECT GGC86 - SAMPLE GGC3

HP5880A GC Analysis Report

Retention Time	Concentration ppbcarbon	CAL#	Compound
20.377	3.33	354	C9 OLEFIN
20.495	3.93	201	C9 PARAFFIN
20.659	4.21	202	C9 PARAFFIN
20.775	7.77	203	C9 OLEFIN
21.012	16.04	206	C9 PARAFFIN
21.103	10.79	208	C9 PARAFFIN
21.199	3.62	209	C9 PARAFFIN
21.252	24.37	210	C9 PARAFFIN
21.343	3.35	211	C9 PARAFFIN
21.390	1.55	0	
21.419	2.26	212	C9 PARAFFIN
21.580	17.88	213	ETHYLBENZENE
21.670	5.97	214	C9 PARAFFIN
21.812	49.71	215	m&p-XYLENE
21.969	12.85	216	C9 PARAFFIN
22.046	4.43	217	C9 PARAFFIN
22.159	16.02	218	C9 PARAFFIN
22.312	6.91	220	C9 OLEFIN
22.439	16.70	222	o-XYLENE
22.507	2.44	223	C9 PARAFFIN
22.579	15.25	224	C9 PARAFFIN
22.683	3.37	226	C9 PARAFFIN
22.760	3.27	227	C9 PARAFFIN
22.875	26.00	228	n-NONANE
23.003	6.71	229	C10 PARAFFIN
23.061	3.19	230	C10 PARAFFIN
23.136	8.02	231	C10 PARAFFIN
23.293	1.40	232	C10 PARAFFIN
23.357	1.26	233	C10 PARAFFIN
23.460	12.04	234	C10 PARAFFIN
23.563	1.18	235	C10 PARAFFIN
23.624	2.42	400	C10 PARAFFIN
23.717	8.57	237	C10 PARAFFIN
23.791	19.90	238	C10 PARAFFIN
23.868	4.85	239	C10 OLEFIN
24.005	6.31	241	C10 PARAFFIN
24.052	7.35	242	n-PROPYLBENZENE
24.136	2.68	243	C10 PARAFFIN
24.181	2.54	0	
24.228	14.66	244	p-ETHYLTOLUENE
24.294	13.67	245	m-ETHYLTOLUENE
24.420	10.52	246	C9 AROMATIC
24.479	14.91	247	C10 PARAFFIN
24.529	11.48	248	C10 PARAFFIN
24.627	1.57	0	
24.692	14.78	249	o-ETHYLTOLUENE
24.853	9.59	250	C9 AROMATIC
24.900	6.57	251	C10 PARAFFIN
24.994	3.80	252	C10 OLEFIN
25.060	31.82	253	1,2,4-TRIMETHYLBENZENE
25.152	6.98	254	C9 AROMATIC
25.226	9.55	255	C10 PARAFFIN
25.362	27.29	256	n-DECANE
25.424	4.07	257	C9 AROMATIC
25.500	4.82	258	C9 AROMATIC
25.618	3.76	259	C9 AROMATIC
25.752	34.32	260	1,2,3-TRIMETHYLBENZENE
25.946	16.80	263	C11 PARAFFIN
26.060	7.34	264	C10 AROMATIC
26.110	5.55	0	
26.236	14.65	265	C10 AROMATIC
26.344	5.80	266	C10 AROMATIC
26.412	11.39	267	C10 AROMATIC
26.553	13.44	268	C10 AROMATIC
26.670	7.28	270	C10 AROMATIC
26.724	2.43	271	C11 PARAFFIN
26.797	4.99	272	C10 AROMATIC
26.877	9.09	273	C11 PARAFFIN
26.968	2.64	373	C10 AROMATIC
27.025	5.46	275	C10 AROMATIC
27.069	7.94	276	1,2-DIMETHYL-4-ETHYLBENZENE
27.202	5.39	277	C10 AROMATIC
27.273	8.52	278	C10 AROMATIC
27.368	5.41	356	C10 AROMATIC
27.426	7.02	279	C11 PARAFFIN
27.594	2.01	281	C10 AROMATIC
27.651	32.59	282	1,2-DIMETHYL-3-ETHYLBENZENE
27.796	3.20	283	C10 AROMATIC
27.883	1.71	284	1,2,4,5-TETRAMETHYLBENZENE
27.957	6.28	285	1,2,3,5-TETRAMETHYLBENZENE
28.038	12.49	286	C10 AROMATIC
28.187	9.60	288	C10 AROMATIC
28.302	10.23	374	C10 AROMATIC
28.450	9.56 !	290	C11 AROMATIC
28.495	3.21	291	C11 AROMATIC
28.564	15.50	292	C11 AROMATIC

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Retention Time	Concentration ppbcarbon	CAL#	Compound
28.694	10.84	293	C11 AROMATIC
28.759	6.91	294	C11 AROMATIC
28.858	10.60	380	C11 AROMATIC
28.954	5.01	296	C11 AROMATIC
29.042	9.72	297	C11 AROMATIC
29.110	1.70	298	C11 AROMATIC
29.190	5.47	299	C11 AROMATIC
29.277	3.54	377	C11 AROMATIC
29.410	15.03	300	C11 AROMATIC
29.498	6.29	0	
29.549	6.34	301	C11 AROMATIC
29.594	2.16	0	
29.652	8.03	302	C11 AROMATIC
29.722	11.87	303	C11 AROMATIC
29.777	28.70	304	C12 PARAFFIN
29.907	7.85	305	C11 AROMATIC
29.987	2.98	306	C11 AROMATIC
30.110	24.79	416	C11 AROMATIC
30.292	4.46	359	C11 AROMATIC
30.428	3.30	310	C11 AROMATIC
30.482	4.04	360	C11 AROMATIC
30.587	8.20	312	C12 PARAFFIN
30.656	2.67	313	C11 AROMATIC
30.735	7.43	314	C12 AROMATIC
30.813	10.39	361	C12 AROMATIC
31.027	5.04	316	C12 AROMATIC
31.109	11.18	317	C12 AROMATIC
31.225	3.93	319	C12 AROMATIC
31.306	14.41	320	C12 AROMATIC
31.420	6.71	321	C12 AROMATIC
31.491	1.03	322	C12 AROMATIC
31.598	1.73	362	C12 AROMATIC
31.724	19.16	363	C12 AROMATIC
31.769	22.29	323	C12 AROMATIC
31.860	2.74	324	C12 AROMATIC
31.890	2.99	0	
31.967	3.79	325	C12 AROMATIC
32.049	11.89	326	C12 AROMATIC
32.169	7.06	327	C12 AROMATIC
32.277	1.71	404	C12 AROMATIC
32.366	0.58	329	C12 AROMATIC
32.447	2.31	330	C12 AROMATIC
32.544	4.85	331	C12 AROMATIC
32.637	2.52	332	C12 AROMATIC
32.754	7.81	333	C12 AROMATIC
32.960	4.20	336	C12 AROMATIC
33.042	7.23	0	
33.227	1.47	381	C12 AROMATIC
33.327	6.02	337	C12 AROMATIC
33.441	0.88	0	
33.575	1.48	0	
33.687	4.95	339	C12 AROMATIC
33.802	3.19	0	
34.381	0.84	405	C12 AROMATIC
34.522	0.88	0	
34.774	1.50	0	
35.568	1.12	406	C12 AROMATIC
*** Total ***	1799.06		

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Page No.       1            PROJECT GGC86 - SAMPLE GGC4
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Retention  Concentration
    Time       ppbcarbon        CAL#  Compound


   1.855          1.38             0
   1.895          0.78             0
   1.974         23.24             0
   2.933          0.26           104 PROPENE
   3.029         30.64           105 PROPANE
   3.140          0.87             0
   4.316          0.48           383 C3 PARAFFIN
   4.995          5.35           110 ISOBUTANE
   6.342         15.71           115 n-BUTANE
   9.276          7.59           119 ISOPENTANE
   9.657          0.56             0
  10.305          6.54           124 n-PENTANE
  10.480          0.20           125 ISOPRENE
  11.063          0.35           129 c-2-PENTENE
  12.044          0.15           135 C6 OLEFIN
  12.212          0.70           385 C6 PARAFFIN
  12.393          1.58           138 CYCLOPENTANE
  12.545          0.31           139 2,3-DIMETHYLBUTANE
  12.742          2.70           141 2-METHYLPENTANE
  12.970         53.92           407 C6 PARAFFIN
  13.134          6.39           144 C6 OLEFIN
  13.220          4.20           145 3-METHYLPENTANE
  13.333          2.59           376 C6 OLEFIN
  13.842          2.40           148 n-HEXANE
  14.666          2.53           156 METHYLCYCLOPENTANE
  14.953          0.44           158 C7 PARAFFIN
  15.128          0.70           159 C7 OLEFIN
  15.383          0.53           364 C7 OLEFIN
  15.464          6.52           162 BENZENE
  15.615          6.45           163 3,3-DIMETHYLPENTANE
  15.782        433.03           164 CYCLOHEXANE
  16.185         23.12           167 2,3-DIMETHYLPENTANE
  16.410         12.79           347 C7 PARAFFIN
  16.503          2.45           171 C7 PARAFFIN
  16.739          2.26           172 C7 PARAFFIN
  17.154          1.17           175 n-HEPTANE
  17.482          3.35           177 C8 OLEFIN
  17.777          1.25           179 METHYLCYCLOHEXANE
  17.875          1.08           366 C8 PARAFFIN
  18.237          0.26           181 C8 PARAFFIN
  18.610          2.18           183 C8 PARAFFIN
  18.831         58.88           185 TOLUENE
  19.087          0.77           188 C8 PARAFFIN
  19.170          1.44           189 C8 PARAFFIN
  19.295          1.19           352 C8 PARAFFIN
  19.397          0.20           191 C8 PARAFFIN
  19.585          1.08           192 C8 PARAFFIN
  20.100          4.22           197 C8 PARAFFIN
  20.676          1.84           202 C9 PARAFFIN
  20.778         35.39           203 C9 OLEFIN
  20.998          0.57           206 C9 PARAFFIN
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Page No.      2           PROJECT 6GC86 - SAMPLE GGC4
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Retention  Concentration
     Time      ppbcarbon        CAL#  Compound


   21.094           0.19         208 C9 PARAFFIN
   21.244           0.57         210 C9 PARAFFIN
   21.567           0.94         213 ETHYLBENZENE
   21.795         126.92         215 m&p-XYLENE
   21.951           0.99         216 C9 PARAFFIN
   22.044           4.92         217 C9 PARAFFIN
   22.169           3.58         218 C9 PARAFFIN
   22.426         115.56         222 o-XYLENE
   22.562           0.48         224 C9 PARAFFIN
   22.666           0.37         226 C9 PARAFFIN
   22.868           0.90         228 n-NONANE
   23.179           8.33         231 C10 PARAFFIN
   23.282           1.56         232 C10 PARAFFIN
   23.368           0.50         233 C10 PARAFFIN
   23.506           0.43         235 C10 PARAFFIN
   23.645           2.64         236 C10 PARAFFIN
   23.710           0.44         237 C10 PARAFFIN
   23.846           7.78         239 C10 OLEFIN
   23.887           4.97           0
   24.100           0.16         243 C10 PARAFFIN
   24.230           0.56         244 p-ETHYLTOLUENE
   24.324           0.79         245 m-ETHYLTOLUENE
   24.427           0.39         246 C9 AROMATIC
   24.472           0.31         247 C10 PARAFFIN
   24.730           1.68         249 o-ETHYLTOLUENE
   24.860           0.47         251 C10 PARAFFIN
   25.002           4.66         252 C10 OLEFIN
   25.046           4.50         253 1,2,4-TRIMETHYLBENZENE
   25.175           0.71         254 C9 AROMATIC
   25.277          22.28         255 C10 PARAFFIN
   25.373           0.97         256 n-DECANE
   25.724           0.75         260 1,2,3-TRIMETHYLBENZENE
   25.807          94.01         261 C11 PARAFFIN
   26.007           6.54         264 C10 AROMATIC
   26.141           0.87           0
   26.283           1.10         266 C10 AROMATIC
   26.434           1.64         267 C10 AROMATIC
   26.550           5.51         268 C10 AROMATIC
   26.885           0.49         273 C11 PARAFFIN
   27.072           2.46         276 1,2-DIMETHYL-4-ETHYLBENZENE
   27.117           1.61         402 C10 AROMATIC
   27.224           0.68         277 C10 AROMATIC
   27.287           0.29         278 C10 AROMATIC
   27.377           8.69         356 C10 AROMATIC
   27.523           0.21         280 C10 AROMATIC
   27.651           1.45         282 1,2-DIMETHYL-3-ETHYLBENZENE
   27.975           0.45         285 1,2,3,5-TETRAMETHYLBENZENE
   28.085           2.37         287 C11 PARAFFIN
   28.183           0.40         288 C10 AROMATIC
   28.519           3.79         291 C11 AROMATIC
   28.707           1.06         293 C11 AROMATIC
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Page No.      3          PROJECT GGC86 - SAMPLE GGC4
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                           HP5880A GC Analysis Report

Retention  Concentration
   Time       ppbcarbon        CAL#  Compound


   28.774          0.39         294 C11 AROMATIC
   28.860          0.24         380 C11 AROMATIC
   28.964          1.22         296 C11 AROMATIC
   29.053          0.24         297 C11 AROMATIC
   29.194          0.52         299 C11 AROMATIC
   29.428          2.12         300 C11 AROMATIC
   29.510          0.35           0
   29.565          0.57         301 C11 AROMATIC
   29.737          1.20         303 C11 AROMATIC
   29.788          2.87         304 C12 PARAFFIN
   29.921          0.32         305 C11 AROMATIC
   30.121          1.88         416 C11 AROMATIC
   30.303          0.47         359 C11 AROMATIC
   30.490          0.18         360 C11 AROMATIC
   30.592          0.55         311 C11 AROMATIC
   30.667          0.07         313 C11 AROMATIC
   30.743          0.60         314 C12 AROMATIC
   30.825          1.11         361 C12 AROMATIC
   31.007          0.64         316 C12 AROMATIC
   31.113          1.89         317 C12 AROMATIC
   31.238          0.45         319 C12 AROMATIC
   31.315          2.77         320 C12 AROMATIC
   31.410          0.40           0
   31.502          0.08         322 C12 AROMATIC
   31.681          1.53           0
   31.778          7.73         323 C12 AROMATIC
   31.862          1.92         324 C12 AROMATIC
   32.067          2.00         326 C12 AROMATIC
   32.187          0.27         327 C12 AROMATIC
   32.280          0.09         404 C12 AROMATIC
   32.375          0.22         329 C12 AROMATIC
   32.452          0.44         330 C12 AROMATIC
   32.555          1.25         331 C12 AROMATIC
   32.640          0.32         332 C12 AROMATIC
   32.764          2.25         333 C12 AROMATIC
   32.890          0.04         334 C12 AROMATIC
   32.963          1.12         335 C13 PARAFFIN
   33.039          2.66         336 C12 AROMATIC
   33.163          0.18         410 C12 AROMATIC
   33.240          0.37         381 C12 AROMATIC
   33.324          3.21         337 C12 AROMATIC
   33.455          0.14           0
   33.587          0.68           0
   33.692          6.76         339 C12 AROMATIC
   33.814          1.85           0
   34.177          0.10         411 C12 AROMATIC
   34.257          0.86         390 C12 AROMATIC
   34.785          0.62           0
   35.572          0.82         406 C12 AROMATIC


*** Total ***
                 1287.06
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Page No.      1            PROJECT GGC86 - SAMPLE GGC5
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Retention  Concentration
     Time      ppbcarbon          CAL#  Compound

    1.876           1.40             0
    1.985          17.91             0
    2.963           0.44             0
    3.056          20.00             0
    5.013           3.64           110 ISOBUTANE
    6.018           1.78           113 2-METHYL PROPYLENE
    6.357          11.02           115 n-BUTANE
    9.285           5.60           119 ISOPENTANE
   10.202           2.99           123 2-METHYL-1-BUTENE
   10.324           3.62           124 n-PENTANE
   11.088           3.27           129 c-2-PENTENE
   11.463           0.18           132 C6 PARAFFIN
   12.098           1.50           135 C6 OLEFIN
   12.402           0.80           137 C6 OLEFIN
   12.798           1.76           141 2-METHYLPENTANE
   13.177           4.04           369 C6 PARAFFIN
   13.563           3.71           344 C6 OLEFIN
   13.917           1.76           148 n-HEXANE
   14.681           1.99           156 METHYLCYCLOPENTANE
   15.354           6.57           160 C7 OLEFIN
   15.521           1.55           162 BENZENE
   15.757           0.94           163 3,3-DIMETHYLPENTANE
   16.182          10.44           166 2-METHYLHEXANE
   16.443           1.76           170 3-METHYLHEXANE
   16.561           4.84             0
   16.685           1.02           365 C7 PARAFFIN
   16.772           1.02           172 C7 PARAFFIN
   16.877           0.30           173 2,2,4-TRIMETHYLPENTANE
   17.216           1.76           175 n-HEPTANE
   17.585          13.45           178 C8 OLEFIN
   17.800           1.01           179 METHYLCYCLOHEXANE
   18.170           0.15           180 C8 PARAFFIN
   18.270           0.21           181 C8 PARAFFIN
   18.446           0.37           182 C8 PARAFFIN
   18.658           0.14           183 C8 PARAFFIN
   18.751           2.13           184 2,3,4-TRIMETHYLPENTANE
   18.890           4.82           185 TOLUENE
   19.217           0.55           189 C8 PARAFFIN
   19.376           0.13           352 C8 PARAFFIN
   19.440           0.08           191 C8 PARAFFIN
   19.491           0.09             0
   19.538           0.25           192 C8 PARAFFIN
   19.675           4.75             0
   19.890           0.15           194 C8 PARAFFIN
   20.117           0.34           197 C8 PARAFFIN
   20.198           1.20           198 n-OCTANE
   20.297           0.84           199 C9 PARAFFIN
   20.653           1.23           389 C9 PARAFFIN
   20.862           1.66           204 C9 PARAFFIN
   21.050           0.26           206 C9 PARAFFIN
   21.120           0.38           207 C9 PARAFFIN
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Retention Time	Concentration ppbcarbon	CAL#	Compound
21.272	1.08	209	C9 PARAFFIN
21.365	0.19	398	C9 PARAFFIN
21.425	0.29	211	C9 PARAFFIN
21.556	0.46	0	
21.623	0.67	213	ETHYLBENZENE
21.858	3.75	215	m&p-XYLENE
22.125	1.06	217	C9 PARAFFIN
22.212	2.33	218	C9 PARAFFIN
22.313	0.17	219	C9 PARAFFIN
22.459	6.75	222	o-XYLENE
22.623	0.45	224	C9 PARAFFIN
22.910	0.78	228	n-NONANE
23.160	14.57	231	C10 PARAFFIN
23.413	0.25	233	C10 PARAFFIN
23.470	0.52	234	C10 PARAFFIN
23.684	0.55	236	C10 PARAFFIN
23.741	0.81	237	C10 PARAFFIN
23.877	8.48	239	C10 OLEFIN
24.260	0.72	244	p-ETHYLTOLUENE
24.344	0.67	245	m-ETHYLTOLUENE
24.390	0.30	0	
24.497	0.18	247	C10 PARAFFIN
24.696	6.44	249	o-ETHYLTOLUENE
25.024	6.22	252	C10 OLEFIN
25.097	3.09	253	1,2,4-TRIMETHYLBENZENE
25.301	2.41	255	C10 PARAFFIN
25.389	0.59	256	n-DECANE
25.816	23.30	260	1,2,3-TRIMETHYLBENZENE
25.971	0.50	263	C11 PARAFFIN
26.157	0.17	264	C10 AROMATIC
26.253	0.40	265	C10 AROMATIC
26.300	0.49	0	
26.494	7.83	401	C10 AROMATIC
26.690	0.10	269	C10 AROMATIC
26.753	0.15	271	C11 PARAFFIN
26.897	0.52	273	C11 PARAFFIN
27.053	0.15	275	C10 AROMATIC
27.143	0.19	402	C10 AROMATIC
27.237	0.39	277	C10 AROMATIC
27.301	0.41	278	C10 AROMATIC
27.390	10.39	355	C11 OLEFIN
27.673	0.66	282	1,2-DIMETHYL-3-ETHYLBENZENE
27.860	0.11	283	C10 AROMATIC
27.990	0.53	285	1,2,3,5-TETRAMETHYLBENZENE
28.106	1.16	287	C11 PARAFFIN
28.207	0.49	288	C10 AROMATIC
28.331	0.16	374	C10 AROMATIC
28.476	0.23	290	C11 AROMATIC
28.531	0.08	291	C11 AROMATIC
28.580	0.49	292	C11 AROMATIC
28.686	3.39	293	C11 AROMATIC
28.788	0.27	294	C11 AROMATIC
28.964	0.37	296	C11 AROMATIC
29.220	1.77	299	C11 AROMATIC
29.439	2.44	300	C11 AROMATIC
29.577	0.20	301	C11 AROMATIC
29.740	0.48	303	C11 AROMATIC
29.798	1.50	304	C12 PARAFFIN
29.937	0.19	305	C11 AROMATIC
30.133	1.44	416	C11 AROMATIC
30.312	0.24	359	C11 AROMATIC
30.605	0.34	311	C11 AROMATIC
30.680	0.06	313	C11 AROMATIC
30.744	0.16	314	C12 AROMATIC
30.838	0.28	361	C12 AROMATIC
31.043	0.13	316	C12 AROMATIC
31.137	0.70	317	C12 AROMATIC
31.352	1.14	320	C12 AROMATIC
31.704	0.33	0	
31.757	0.20	363	C12 AROMATIC
31.827	1.12	324	C12 AROMATIC
31.923	0.51	325	C12 AROMATIC
32.083	0.34	326	C12 AROMATIC
32.470	0.16	330	C12 AROMATIC
32.797	0.78	333	C12 AROMATIC
32.981	0.32	335	C13 PARAFFIN
33.057	0.69	336	C12 AROMATIC
33.190	0.10	410	C12 AROMATIC
33.345	1.28	337	C12 AROMATIC
33.453	0.60	0	
33.722	2.71	339	C12 AROMATIC
33.837	0.42	0	
34.806	0.72	0	
35.591	0.46	406	C12 AROMATIC
*** Total ***	290.32		

Page No. 1 PROJECT GGC86 - SAMPLE GGC6
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Retention Time	Concentration ppbcarbon	CAL#	Compound
1.564	5.37	0	
1.848	3.92	0	
1.965	46.75	103	ACETYLENE
3.022	57.86	105	PROPANE
4.406	0.39	0	
4.993	17.44	110	ISOBUTANE
5.577	0.18	112	Unknown
6.024	2.23	0	
6.342	42.63	115	n-BUTANE
6.863	0.44	0	
7.730	0.12	0	
9.272	25.43	119	ISOPENTANE
9.647	0.17	0	
9.900	0.96	121	1-PENTENE
9.983	0.52	394	C5 OLEFIN
10.158	0.42	123	2-METHYL-1-BUTENE
10.287	22.74	124	n-PENTANE
11.050	0.64	129	c-2-PENTENE
11.418	2.11	132	C6 PARAFFIN
11.510	0.66	133	2,2-DIMETHYLBUTANE
11.955	0.51	396	C5 OLEFIN
12.467	4.81	138	CYCLOPENTANE
12.525	1.99	0	
12.606	3.35	139	2,3-DIMETHYLBUTANE
12.802	12.09	141	2-METHYLPENTANE
13.038	34.52	407	C6 PARAFFIN
13.282	14.09	145	3-METHYLPENTANE
13.423	5.28	376	C6 OLEFIN
13.612	2.10	0	
13.902	10.57	148	n-HEXANE
14.729	21.23	156	METHYLCYCLOPENTANE
14.921	2.01	157	2,4-DIMETHYLPENTANE
15.013	3.63	158	C7 PARAFFIN
15.220	1.34	0	
15.526	3.53	162	BENZENE
15.696	3.00	163	3,3-DIMETHYLPENTANE
15.809	10.71	164	CYCLOHEXANE
15.995	20.59	346	C7 OLEFIN
16.159	15.21	166	2-METHYLHEXANE
16.268	8.00	168	C7 PARAFFIN
16.431	8.81	170	3-METHYLHEXANE
16.502	3.38	347	C7 PARAFFIN
16.615	9.88	171	C7 PARAFFIN
16.703	8.87	365	C7 PARAFFIN
16.790	18.69	172	C7 PARAFFIN
17.198	8.41	175	n-HEPTANE
17.537	19.47	177	C8 OLEFIN
17.815	25.70	179	METHYLCYCLOHEXANE
17.910	5.77	366	C8 PARAFFIN
18.176	5.09	180	C8 PARAFFIN
18.252	2.10	181	C8 PARAFFIN

Page No. 2 PROJECT GGC86 - SAMPLE GGC6
08/05/86

HP5880A GC Analysis Report

Retention Time	Concentration ppbcarbon	CAL#	Compound
18.435	7.12	182	C8 PARAFFIN
18.655	11.61	183	C8 PARAFFIN
18.736	1.95	184	2,3,4-TRIMETHYLPENTANE
18.872	16.69	185	TOLUENE
19.048	1.61	187	C8 PARAFFIN
19.100	2.53	188	C8 PARAFFIN
19.207	8.65	189	C8 PARAFFIN
19.319	0.89	352	C8 PARAFFIN
19.430	5.28	191	C8 PARAFFIN
19.535	12.34	192	C8 PARAFFIN
19.589	7.10	0	
19.760	2.78	193	C8 PARAFFIN
19.840	2.26	194	C8 PARAFFIN
19.939	7.46	195	C8 PARAFFIN
20.110	6.27	197	C8 PARAFFIN
20.177	5.32	198	n-OCTANE
20.217	11.93	199	C9 PARAFFIN
20.307	3.24	200	C9 PARAFFIN
20.505	1.61	201	C9 PARAFFIN
20.602	0.34	389	C9 PARAFFIN
20.672	1.28	202	C9 PARAFFIN
20.791	1.66	203	C9 OLEFIN
20.851	1.21	204	C9 PARAFFIN
21.024	7.25	206	C9 PARAFFIN
21.114	7.13	208	C9 PARAFFIN
21.263	18.69	210	C9 PARAFFIN
21.352	2.49	211	C9 PARAFFIN
21.450	6.27	212	C9 PARAFFIN
21.590	11.62	213	ETHYLBENZENE
21.680	5.03	214	C9 PARAFFIN
21.822	27.30	215	m&p-XYLENE
21.976	4.77	216	C9 PARAFFIN
22.054	6.99	217	C9 PARAFFIN
22.163	7.39	218	C9 PARAFFIN
22.322	4.99	220	C9 OLEFIN
22.447	12.41	222	o-XYLENE
22.622	11.93	225	C9 PARAFFIN
22.690	2.76	226	C9 PARAFFIN
22.769	2.11	227	C9 PARAFFIN
22.882	6.35	228	n-NONANE
23.009	2.77	229	C10 PARAFFIN
23.069	0.86	230	C10 PARAFFIN
23.143	4.93	231	C10 PARAFFIN
23.216	1.13	0	
23.300	1.23	232	C10 PARAFFIN
23.386	1.55	233	C10 PARAFFIN
23.466	7.67	234	C10 PARAFFIN
23.622	5.26	400	C10 PARAFFIN
23.722	7.36	237	C10 PARAFFIN
23.817	18.14	238	C10 PARAFFIN
23.874	9.63	239	C10 OLEFIN

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Page No.     3          PROJECT GGC86 - SAMPLE GGC6
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Retention  Concentration
   Time      ppbcarbon          CAL#  Compound


   24.006            5.48        241 C10 PARAFFIN
   24.057            4.04        242 n-PROPYLBENZENE
   24.142            2.55        243 C10 PARAFFIN
   24.235            5.47        244 p-ETHYLTOLUENE
   24.310            6.27        245 m-ETHYLTOLUENE
   24.427            5.41        246 C9 AROMATIC
   24.488            7.64        247 C10 PARAFFIN
   24.531            7.58        248 C10 PARAFFIN
   24.696            8.27        249 o-ETHYLTOLUENE
   24.857            3.67        250 C9 AROMATIC
   24.997            3.98        252 C10 OLEFIN
   25.068           15.98        253 1,2,4-TRIMETHYLBENZENE
   25.157            3.86        254 C9 AROMATIC
   25.231            4.78        255 C10 PARAFFIN
   25.368            8.95        256 n-DECANE
   25.430            1.65        257 C9 AROMATIC
   25.503            3.06        258 C9 AROMATIC
   25.621            1.80        259 C9 AROMATIC
   25.757           16.04        260 1,2,3-TRIMETHYLBENZENE
   25.950            8.33        263 C11 PARAFFIN
   26.061            4.52        264 C10 AROMATIC
   26.111            4.01          0
   26.238           10.20        265 C10 AROMATIC
   26.409           11.58        267 C10 AROMATIC
   26.497            7.67        401 C10 AROMATIC
   26.560            5.70        268 C10 AROMATIC
   26.676            5.82        270 C10 AROMATIC
   26.729            2.28        271 C11 PARAFFIN
   26.883           12.86        273 C11 PARAFFIN
   26.974            3.70        373 C10 AROMATIC
   27.031            3.59        275 C10 AROMATIC
   27.080            5.73        276 1,2-DIMETHYL-4-ETHYLBENZENE
   27.210            4.03        277 C10 AROMATIC
   27.286            5.27        278 C10 AROMATIC
   27.374           20.49        356 C10 AROMATIC
   27.657           17.56        282 1,2-DIMETHYL-3-ETHYLBENZENE
   27.802            2.76        283 C10 AROMATIC
   27.893            1.62        284 1,2,4,5-TETRAMETHYLBENZENE
   27.965            3.35        285 1,2,3,5-TETRAMETHYLBENZENE
   28.047            6.05        286 C10 AROMATIC
   28.192            5.76        288 C10 AROMATIC
   28.310            4.72        374 C10 AROMATIC
   28.454            3.10        290 C11 AROMATIC
   28.566            8.73        292 C11 AROMATIC
   28.698            5.06        293 C11 AROMATIC
   28.769            2.57        294 C11 AROMATIC
   28.888            3.55        380 C11 AROMATIC
   28.961            1.81        296 C11 AROMATIC
   29.046            4.16        297 C11 AROMATIC
   29.197            2.40        299 C11 AROMATIC
   29.279            2.34        377 C11 AROMATIC
   29.421            5.92        300 C11 AROMATIC
   29.506            1.94          0
   29.556            1.95        301 C11 AROMATIC
   29.653            3.66        302 C11 AROMATIC
   29.725            3.98        303 C11 AROMATIC
   29.785            6.48        304 C12 PARAFFIN
   29.917            2.71        305 C11 AROMATIC
   29.987            1.25        306 C11 AROMATIC
   30.124            6.23        416 C11 AROMATIC
   30.298            2.42        359 C11 AROMATIC
   30.398            1.05        409 C11 AROMATIC
   30.489            1.45        360 C11 AROMATIC
   30.593            3.05        311 C11 AROMATIC
   30.663            1.19        313 C11 AROMATIC
   30.737            1.69        314 C12 AROMATIC
   30.827            3.21        361 C12 AROMATIC
   31.031            2.25        316 C12 AROMATIC
   31.119            3.20        317 C12 AROMATIC
   31.239            0.94        319 C12 AROMATIC
   31.323            4.44        320 C12 AROMATIC
   31.422            2.43        321 C12 AROMATIC
   31.608            0.54        362 C12 AROMATIC
   31.687            0.98          0
   31.748            1.34        323 C12 AROMATIC
   31.796            1.47          0
   31.915            2.05        325 C12 AROMATIC
   32.080            0.50        326 C12 AROMATIC
   32.175            0.55        327 C12 AROMATIC
   32.233            0.84        328 C13 PRAFFIN
   32.291            0.58        404 C12 AROMATIC
   32.457            0.49        330 C12 AROMATIC
   32.765            0.87        333 C12 AROMATIC
   33.050            1.06        336 C12 AROMATIC
   33.334            0.90        337 C12 AROMATIC
   33.434            3.76          0
*** Total ***
                      1238.02  !
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Page No.      1          PROJECT GGC86 - SAMPLE GGC7
08/04/86
                            HP5880A GC Analysis Report

Retention  Concentration
     Time      ppbcarbon       CAL#  Compound


    1.557           3.73          0
    1.992          45.98          0
    3.047          47.96        105 PROPANE
    3.167           1.33          0
    5.015          13.59        110 ISOBUTANE
    6.044           1.52          0
    6.362          33.89        115 n-BUTANE
    9.295          16.25        119 ISOPENTANE
    9.770           0.55          0
   10.349          12.20        124 n-PENTANE
   11.475           1.40        132 C6 PARAFFIN
   11.575           1.01        133 2,2-DIMETHYLBUTANE
   12.354           1.13        385 C6 PARAFFIN
   12.506           3.17        138 CYCLOPENTANE
   12.659           2.50        139 2,3-DIMETHYLBUTANE
   12.871           5.96        141 2-METHYLPENTANE
   13.340           5.10        145 3-METHYLPENTANE
   13.673           1.15          0
   13.974           4.88        148 n-HEXANE
   14.164           1.01        150 C7 OLEFIN
   14.390           0.20        153 C7 OLEFIN
   14.768          13.98        156 METHYLCYCLOPENTANE
   14.987           0.91        157 2,4-DIMETHYLPENTANE
   15.062           1.91        158 C7 PARAFFIN
   15.600           2.87        162 BENZENE
   15.756           0.15        163 3,3-DIMETHYLPENTANE
   15.838           7.91          0
   16.102           0.84        346 C7 OLEFIN
   16.244           5.17        166 2-METHYLHEXANE
   16.303           1.97        167 2,3-DIMETHYLPENTANE
   16.480           4.28        170 3-METHYLHEXANE
   16.654           6.34          0
   16.740           6.01        365 C7 PARAFFIN
   16.825          10.80        172 C7 PARAFFIN
   16.891           1.58        173 2,2,4-TRIMETHYLPENTANE
   17.248           2.57        175 n-HEPTANE
   17.557           1.32        177 C8 OLEFIN
   17.847          17.99        179 METHYLCYCLOHEXANE
   17.944           4.02        366 C8 PARAFFIN
   18.206           3.14        180 C8 PARAFFIN
   18.289           1.35        181 C8 PARAFFIN
   18.467           5.36        182 C8 PARAFFIN
   18.684           9.83        183 C8 PARAFFIN
   18.767           0.93        184 2,3,4-TRIMETHYLPENTANE
   18.920           9.68        185 TOLUENE
   19.077           0.69        186 C8 PARAFFIN
   19.127           1.95        187 C8 PARAFFIN
   19.242           3.27        189 C8 PARAFFIN
   19.460           2.56        191 C8 PARAFFIN
   19.562           9.81          0
   19.611           2.50        192 C8 PARAFFIN
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Page No.      2          PROJECT GGC86 - SAMPLE GGC7
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Retention  Concentration
    Time      ppbcarbon        CAL#  Compound


    19.785          1.70        193 C8 PARAFFIN
    19.862          1.03        194 C8 PARAFFIN
    19.962          4.16        353 C8 PARAFFIN
    20.132          5.40       ·197 C8 PARAFFIN
    20.242         13.18        198 n-OCTANE
    20.328          2.62        200 C9 PARAFFIN
    20.529          1.55        201 C9 PARAFFIN
    20.738          2.83        202 C9 PARAFFIN
    20.807          0.63        203 C9 OLEFIN
    21.003          1.50        205 C9 PARAFFIN
    21.048          2.79        206 C9 PARAFFIN
    21.133          4.39        207 C9 PARAFFIN
    21.202         14.31        209 C9 PARAFFIN
    21.3[illegible]8          0.63        398 C9 PARAFFIN
    21.450          0.47        211 C9 PARAFFIN
    21.612          5.92        213 ETHYLBENZENE
    21.701          3.95        214 C9 PARAFFIN
    21.794          3.27        399 C9 PARAFFIN
    21.863          9.42        215 m&p-XYLENE
    21.997          3.61          0
    22.062          2.71        367 C9 PARAFFIN
    22.197          5.11        218 C9 PARAFFIN
    22.335          4.48        220 C9 OLEFIN
    22.482          8.05        222 o-XYLENE
    22.637          6.65        224 C9 PARAFFIN
    22.706          2.11        225 C9 PARAFFIN
    22.782          2.03        226 C9 PARAFFIN
    22.907          2.18        228 n-NONANE
    23.027          3.38          0
    23.082          0.91        229 C10 PARAFFIN
    23.160          4.32        230 C10 PARAFFIN
    23.400          1.11        233 C10 PARAFFIN
    23.477          7.33        234 C10 PARAFFIN
    23.640          0.67        400 C10 PARAFFIN
    23.735          4.80        236 C10 PARAFFIN
    23.816          4.16        238 C10 PARAFFIN
    23.893          1.65        239 C10 OLEFIN
    24.024          2.95        240 C10 OLEFIN
    24.087          0.97        242 n-PROPYLBENZENE
    24.156          0.17        243 C10 PARAFFIN
    24.267          2.33        244 p-ETHYLTOLUENE
    24.340          2.26        245 m-ETHYLTOLUENE
    24.457          2.10        246 C9 AROMATIC
    24.501          6.16        247 C10 PARAFFIN
    24.555          3.95        248 C10 PARAFFIN
    24.726          3.99        249 o-ETHYLTOLUENE
    24.869          3.60        250 C9 AROMATIC
    24.910          3.23        251 C10 PARAFFIN
    25.016          1.03        252 C10 OLEFIN
    25.097          7.18        253 1,2,4-TRIMETHYLBENZENE
    25.167          2.44        254 C9 AROMATIC
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Page No.      3          PROJECT GGC86 - SAMPLE GGC7
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                          HP5880A GC Analysis Report

Retention  Concentration
    Time       ppbcarbon        CAL#  Compound


    25.242            2.46        255 C10 PARAFFIN
    25.388            3.64        256 n-DECANE
    25.442            1.24        257 C9 AROMATIC
    25.521            2.08        258 C9 AROMATIC
    25.632            1.42        259 C9 AROMATIC
    25.782           11.11        260 1,2,3-TRIMETHYLBENZENE
    25.897            2.34        262 C11 PARAFFIN
    25.970            4.14        263 C11 PARAFFIN
    26.029            2.22          0
    26.120            3.66        264 C10 AROMATIC
    26.197            0.35          0
    26.253            2.05        265 C10 AROMATIC
    26.503            0.72        401 C10 AROMATIC
    26.586            1.91        268 C10 AROMATIC
    26.689            2.49        269 C10 AROMATIC
    26.830            0.86        272 C10 AROMATIC
    26.897            4.22        273 C11 PARAFFIN
    26.985            0.79        373 C10 AROMATIC
    27.053            1.40        275 C10 AROMATIC
    27.106            3.73        276 1,2-DIMETHYL-4-ETHYLBENZENE
    27.236            2.50        277 C10 AROMATIC
    27.299            2.68        278 C10 AROMATIC
    27.433           14.80        356 C10 AROMATIC
    27.627            0.71        281 C10 AROMATIC
    27.679            5.50        282 1,2-DIMETHYL-3-ETHYLBENZENE
    27.815            1.09        283 C10 AROMATIC
    27.990            2.17        285 1,2,3,5-TETRAMETHYLBENZENE
    28.071            3.61        286 C10 AROMATIC
    28.202            3.99        288 C10 AROMATIC
    28.331            0.68        374 C10 AROMATIC
    28.377            0.92        357 C10 AROMATIC
    28.468            2.44        290 C11 AROMATIC
    28.577            6.39        292 C11 AROMATIC
    28.724            1.96        293 C11 AROMATIC
    28.795            1.57        294 C11 AROMATIC
    28.921            1.13        295 C11 AROMATIC
    28.976            0.44        296 C11 AROMATIC
    29.070            1.18        297 C11 AROMATIC
    29.222            0.72        299 C11 AROMATIC
    29.290            0.93        377 C11 AROMATIC
    29.434            1.53        300 C11 AROMATIC
    29.534            0.33        301 C11 AROMATIC
    29.585            0.29          0
    29.660            0.81        302 C11 AROMATIC
    29.760            2.64        303 C11 AROMATIC
    29.806            2.22        304 C12 PARAFFIN
    29.885            0.20          0
    29.937            0.35        305 C11 AROMATIC
    30.147            3.33        308 C11 AROMATIC
    30.318            0.95        359 C11 AROMATIC
    30.517            0.65        360 C11 AROMATIC
    30.609            1.13        311 C11 AROMATIC
    30.676            0.16        313 C11 AROMATIC
    30.851            1.11        361 C12 AROMATIC
    30.993            0.98          0
    31.054            1.29        316 C12 AROMATIC
    31.147            1.13        318 C12 AROMATIC
    31.343            0.17        320 C12 AROMATIC
    31.430            2.12        321 C12 AROMATIC
    31.533            0.24        322 C12 AROMATIC
    31.620            0.25        362 C12 AROMATIC
    31.763            0.91        363 C12 AROMATIC
    32.483            0.37        330 C12 AROMATIC
    32.667            0.82        332 C12 AROMATIC
    32.837            0.34        333 C12 AROMATIC
    33.067            0.81        336 C12 AROMATIC
    33.494            2.21          0
*** Total ***
                        669.20
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Page No.     1              PROJECT GGC86 - SAMPLE GGC8
08/04/86
                                   HP5880A GC Analysis Report

Retention  Concentration
     Time      ppbcarbon        CAL#  Compound


    1.560           5.49           0
    1.870           3.60           0
    1.991          28.49           0
    3.040          33.93         105 PROPANE
    5.006          11.78         110 ISOBUTANE
    6.033           1.80         113 2-METHYL PROPYLENE
    6.356          27.53         115 n-BUTANE
    6.873           0.45           0
    9.283          14.29         119 ISOPENTANE
    9.675           0.24           0
   10.027           3.30         394 C5 OLEFIN
   10.304          13.77         124 n-PENTANE
   11.067           0.35         129 c-2-PENTENE
   11.452           1.01         132 C6 PARAFFIN
   11.545           0.77         133 2,2-DIMETHYLBUTANE
   12.027           2.47         396 C5 OLEFIN
   12.312           0.12         385 C6 PARAFFIN
   12.494           3.12         138 CYCLOPENTANE
   12.562           0.90           0
   12.635           2.77         139 2,3-DIMETHYLBUTANE
   12.835           5.77         141 2-METHYLPENTANE
   13.173           7.69         369 C6 PARAFFIN
   13.312           9.07         145 3-METHYLPENTANE
   13.517           6.03         146 C6 OLEFIN
   13.935           4.73         148 n-HEXANE
   14.754          13.71         156 METHYLCYCLOPENTANE
   14.952           1.08         157 2,4-DIMETHYLPENTANE
   15.039           3.61         158 C7 PARAFFIN
   15.270           0.78           0
   15.561           3.35         162 BENZENE
   15.737           0.47         163 3,3-DIMETHYLPENTANE
   15.830           7.28         164 CYCLOHEXANE
   16.223           9.40         167 2,3-DIMETHYLPENTANE
   16.290           3.99         168 C7 PARAFFIN
   16.459           6.83         170 3-METHYLHEXANE
   16.573           2.49         347 C7 PARAFFIN
   16.638           8.10         171 C7 PARAFFIN
   16.725           6.36         365 C7 PARAFFIN
   16.808          15.44         172 C7 PARAFFIN
   17.225           5.04         175 n-HEPTANE
   17.541           0.84         177 C8 OLEFIN
   17.835          17.24         179 METHYLCYCLOHEXANE
   17.932           4.25         366 C8 PARAFFIN
   18.195           3.96         180 C8 PARAFFIN
   18.275           1.63         181 C8 PARAFFIN
   18.455           6.11         182 C8 PARAFFIN
   18.673          10.20         183 C8 PARAFFIN
   18.751           2.53         184 2,3,4-TRIMETHYLPENTANE
   18.897          12.58         185 TOLUENE
   19.067           1.04         187 C8 PARAFFIN
   19.117           2.26         188 C8 PARAFFIN
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Page No.      2              PROJECT GGC86 - SAMPLE GGC8
08/04/86
                               HP5880A GC Analysis Report

Retention  Concentration
     Time      ppbcarbon      CAL#  Compound


   19.227          5.52        189 C8 PARAFFIN
   19.337          0.99        352 C8 PARAFFIN
   19.449          4.22        191 C8 PARAFFIN
   19.552         13.54        192 C8 PARAFFIN
   19.657          2.73          0
   19.777          2.59        193 C8 PARAFFIN
   19.855          1.87        194 C8 PARAFFIN
   19.954          6.01        353 C8 PARAFFIN
   20.125          5.44        197 C8 PARAFFIN
   20.220         18.57        199 C9 PARAFFIN
   20.321          2.34        200 C9 PARAFFIN
   20.520          1.54        201 C9 PARAFFIN
   20.687          1.52        202 C9 PARAFFIN
   20.800          1.03        203 C9 OLEFIN
   20.868          1.05        204 C9 PARAFFIN
   21.038          5.65        206 C9 PARAFFIN
   21.125          5.51        208 C9 PARAFFIN
   21.275         17.71        210 C9 PARAFFIN
   21.363          2.75        211 C9 PARAFFIN
   21.443          1.60        212 C9 PARAFFIN
   21.606          8.34        213 ETHYLBENZENE
   21.693          3.89        214 C9 PARAFFIN
   21.789          2.40        399 C9 PARAFFIN
   21.843         15.56        215 m&p-XYLENE
   21.989          3.43        216 C9 PARAFFIN
   22.060          1.76        367 C9 PARAFFIN
   22.185          6.89        218 C9 PARAFFIN
   22.335          5.25        220 C9 OLEFIN
   22.467         10.40        222 o-XYLENE
   22.631          7.01        225 C9 PARAFFIN
   22.700          2.23        226 C9 PARAFFIN
   22.779          1.93        227 C9 PARAFFIN
   22.896          3.22        228 n-NONANE
   23.020          2.50        229 C10 PARAFFIN
   23.154          3.35        231 C10 PARAFFIN
   23.314          0.46        232 C10 PARAFFIN
   23.474          7.18        234 C10 PARAFFIN
   23.580          0.57        235 C10 PARAFFIN
   23.636          1.05        400 C10 PARAFFIN
   23.731          5.62        237 C10 PARAFFIN
   23.808          4.97        238 C10 PARAFFIN
   23.899          4.03        239 C10 OLEFIN
   24.017          4.60          0
   24.076          2.73        242 n-PROPYLBENZENE
   24.150          2.73        243 C10 PARAFFIN
   24.253          4.11        244 p-ETHYLTOLUENE
   24.328          4.88        245 m-ETHYLTOLUENE
   24.446          2.49        246 C9 AROMATIC
   24.497          7.05        247 C10 PARAFFIN
   24.547          5.07        248 C10 PARAFFIN
   24.714          5.07        249 o-ETHYLTOLUENE
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Page No.       3           PROJECT GGC86 - SAMPLE GGC8
08/04/86
                              HP5880A GC Analysis Report

Retention  Concentration
   Time       ppbcarbon        CAL#  Compound


    24.864            8.95          250 C9 AROMATIC
    25.012            2.06          252 C10 OLEFIN
    25.088            9.59          253 1,2,4-TRIMETHYLBENZENE
    25.163            3.54          254 C9 AROMATIC
    25.239            4.16          255 C10 PARAFFIN
    25.380            5.49          256 n-DECANE
    25.436            1.77          257 C9 AROMATIC
    25.513            2.55          258 C9 AROMATIC
    25.628            1.58          259 C9 AROMATIC
    25.774           13.20          260 1,2,3-TRIMETHYLBENZENE
    25.963            7.00          263 C11 PARAFFIN
    26.116            5.91          264 C10 AROMATIC
    26.248            8.10          265 C10 AROMATIC
    26.414            7.21          267 C10 AROMATIC
    26.501            2.67          401 C10 AROMATIC
    26.578            3.89          268 C10 AROMATIC
    26.685            6.52          269 C10 AROMATIC
    26.825            2.48          272 C10 AROMATIC
    26.893            6.49          273 C11 PARAFFIN
    26.982            2.44          373 C10 AROMATIC
    27.047            2.65          275 C10 AROMATIC
    27.099            4.49          276 1,2-DIMETHYL-4-ETHYLBENZENE
    27.230            3.55          277 C10 AROMATIC
    27.295            4.07          278 C10 AROMATIC
    27.436           14.18          356 C10 AROMATIC
    27.672           13.02          282 1,2-DIMETHYL-3-ETHYLBENZENE
    27.809            2.67          283 C10 AROMATIC
    27.901            1.66          284 1,2,4,5-TETRAMETHYLBENZENE
    27.989            3.12          285 1,2,3,5-TETRAMETHYLBENZENE
    28.070            4.42          286 C10 AROMATIC
    28.197            5.99          288 C10 AROMATIC
    28.325            1.92          374 C10 AROMATIC
    28.372            1.44          357 C10 AROMATIC
    28.466            2.45          290 C11 AROMATIC
    28.572            7.61          292 C11 AROMATIC
    28.721            2.82          293 C11 AROMATIC
    28.794            2.08          294 C11 AROMATIC
    28.878            2.85          380 C11 AROMATIC
    28.975            1.43          296 C11 AROMATIC
    29.075            5.19          297 C11 AROMATIC
    29.221            1.58          299 C11 AROMATIC
    29.287            2.35          377 C11 AROMATIC
    29.427            3.25          300 C11 AROMATIC
    29.657            5.85            0
    29.725            2.02          302 C11 AROMATIC
    29.805            5.05          304 C12 PARAFFIN
    29.921            2.48          305 C11 AROMATIC
    30.145            4.83          416 C11 AROMATIC
    30.315            2.43          359 C11 AROMATIC
    30.607            2.37          311 C11 AROMATIC
    30.674            1.18          313 C11 AROMATIC
    30.988            0.99            0
    31.049            1.22          316 C12 AROMATIC
    31.135            0.79          317 C12 AROMATIC
    31.337            0.49          320 C12 AROMATIC
    31.432            2.57          321 C12 AROMATIC
    31.762            1.24          363 C12 AROMATIC
    31.990            1.68          325 C12 AROMATIC
    33.065            0.89          336 C12 AROMATIC
    33.495            1.44            0
*** Total ***
                    820.90
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Page No.      1            PROJECT GGC86 - SAMPLE GGC9
08/04/86
                            HP5880A GC Analysis Report

Retention  Concentration
   Time       ppbcarbon        CAL#  Compound


    1.852          1.24          0
    1.899          1.30          0
    1.968         27.55        103 ACETYLENE
    2.960          0.25        104 PROPENE
    3.037         19.48        105 PROPANE
    3.467          0.09        107 PARAFFIN
    5.003          4.71        110 ISOBUTANE
    6.023          0.67        113 2-METHYL PROPYLENE
    6.350         11.26        115 n-BUTANE
    9.277          5.91        119 ISOPENTANE
   10.290          5.15        124 n-PENTANE
   11.436          0.21        132 C6 PARAFFIN
   11.521          0.45        133 2,2-DIMETHYLBUTANE
   11.587          0.06          0
   12.460          1.24        138 CYCLOPENTANE
   12.609          1.32        139 2,3-DIMETHYLBUTANE
   12.815          2.39        141 2-METHYLPENTANE
   13.227          1.76        144 C6 OLEFIN
   13.290          3.60        145 3-METHYLPENTANE
   13.596          0.62        344 C6 OLEFIN
   13.917          2.36        148 n-HEXANE
   14.727          6.03        156 METHYLCYCLOPENTANE
   14.953          0.40        157 2,4-DIMETHYLPENTANE
   15.021          0.48        158 C7 PARAFFIN
   15.306          0.50        415 C7 OLEFIN
   15.557          1.93        162 BENZENE
   15.806          3.40        164 CYCLOHEXANE
   16.220          2.02        167 2,3-DIMETHYLPENTANE
   16.272          1.48          0
   16.455          2.07        170 3-METHYLHEXANE
   16.623          5.99        171 C7 PARAFFIN
   16.710          3.45        365 C7 PARAFFIN
   16.797          3.54        172 C7 PARAFFIN
   17.225          1.28        175 n-HEPTANE
   17.825          6.47        179 METHYLCYCLOHEXANE
   17.923          2.17        366 C8 PARAFFIN
   18.185          1.51        351 C8 OLEFIN
   18.275          0.57        181 C8 PARAFFIN
   18.448          2.95        182 C8 PARAFFIN
   18.666          4.24        183 C8 PARAFFIN
   18.765          1.48        184 2,3,4-TRIMETHYLPENTANE
   18.913          2.04        185 TOLUENE
   19.111          1.02        187 C8 PARAFFIN
   19.235          0.41        189 C8 PARAFFIN
   19.447          0.71        191 C8 PARAFFIN
   19.547          5.19          0
   19.599          1.20        192 C8 PARAFFIN
   19.683          2.66          0
   19.770          1.03        193 C8 PARAFFIN
   19.851          0.51        194 C8 PARAFFIN
   19.951          1.86        353 C8 PARAFFIN
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Page No.      2            PROJECT GGC86 - SAMPLE GGC9
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Retention  Concentration
    Time      ppbcarbon        CAL#  Compound


    20.120             2.59         197 C8 PARAFFIN
    20.208             1.18         198 n-OCTANE
    20.269             1.73         199 C9 PARAFFIN
    20.315             1.02         200 C9 PARAFFIN
    20.517             0.65         201 C9 PARAFFIN
    20.687             0.34         202 C9 PARAFFIN
    20.793             0.40         203 C9 OLEFIN
    20.990             0.63         205 C9 PARAFFIN
    21.056             0.75         206 C9 PARAFFIN
    21.123             2.12         207 C9 PARAFFIN
    21.275             5.49         209 C9 PARAFFIN
    21.367             0.23         398 C9 PARAFFIN
    21.444             0.36         211 C9 PARAFFIN
    21.607             2.03         213 ETHYLBENZENE
    21.698             0.92         214 C9 PARAFFIN
    21.796             0.49         399 C9 PARAFFIN
    21.865             2.13         215 m&p-XYLENE
    22.013             0.53         216 C9 PARAFFIN
    22.058             0.56         367 C9 PARAFFIN
    22.143             0.53         217 C9 PARAFFIN
    22.211             1.42         218 C9 PARAFFIN
    22.331             0.70         220 C9 OLEFIN
    22.477             3.54         222 o-XYLENE
    22.632             0.74         224 C9 PARAFFIN
    22.705             0.47         225 C9 PARAFFIN
    22.907             0.56         228 n-NONANE
    23.029             0.54         229 C10 PARAFFIN
    23.159             0.91         230 C10 PARAFFIN
    23.472             2.40         233 C10 PARAFFIN
    23.638             0.15         400 C10 PARAFFIN
    23.735             1.55         236 C10 PARAFFIN
    23.819             0.85         238 C10 PARAFFIN
    23.906             2.27         239 C10 OLEFIN
    24.025             0.92         240 C10 OLEFIN
    24.090             0.52         242 n-PROPYLBENZENE
    24.269             0.47         244 p-ETHYLTOLUENE
    24.347             0.38         245 m-ETHYLTOLUENE
    24.502             1.81         247 C10 PARAFFIN
    24.551             1.54         248 C10 PARAFFIN
    24.732             0.75         249 o-ETHYLTOLUENE
    24.870             0.19         250 C9 AROMATIC
    25.048             1.56         252 C10 OLEFIN
    25.100             1.29         253 1,2,4-TRIMETHYLBENZENE
    25.389             0.78         256 n-DECANE
    25.635             0.33         259 C9 AROMATIC
    25.706             0.38         408 C9 AROMATIC
    25.792             1.86         260 1,2,3-TRIMETHYLBENZENE
    25.975             0.63         263 C11 PARAFFIN
    26.122             0.62         264 C10 AROMATIC
    26.257             0.41         265 C10 AROMATIC
    26.503             0.14         401 C10 AROMATIC
    26.592             0.17         268 C10 AROMATIC
    26.693             0.27         269 C10 AROMATIC
    26.898             0.81         273 C11 PARAFFIN
    27.060             0.35         275 C10 AROMATIC
    27.113             0.58         276 1,2-DIMETHYL-4-ETHYLBENZENE
    27.302             0.40         278 C10 AROMATIC
    27.423             7.69         356 C10 AROMATIC
    27.681             0.61         282 1,2-DIMETHYL-3-ETHYLBENZENE
    28.007             0.33         285 1,2,3,5-TETRAMETHYLBENZENE
    28.077             0.60         286 C10 AROMATIC
    28.203             0.64         288 C10 AROMATIC
    28.475             0.40         290 C11 AROMATIC
    28.577             1.30         292 C11 AROMATIC
    28.725             0.35         293 C11 AROMATIC
    29.073             0.31         297 C11 AROMATIC
    29.663             0.08         302 C11 AROMATIC
    29.810             0.53         304 C12 PARAFFIN
    30.153             0.62         308 C11 AROMATIC
    30.320             0.11         359 C11 AROMATIC
    30.613             0.20         311 C11 AROMATIC
    31.143             0.05         317 C12 AROMATIC
    31.780             0.10         323 C12 AROMATIC
    32.653             0.35         332 C12 AROMATIC
    33.447             2.15         337 C12 AROMATIC
*** Total ***
                     234.57
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Page No.     1            PROJECT GGC86 - SAMPLE GGC10
08/04/86
                                HP5880A GC Analysis Report

Retention  Concentration
     Time      ppbcarbon       CAL#  Compound


    1.694           1.00          0
    1.815           5.30        102 ETHYLENE
    1.982          25.87          0
    2.877           0.28        104 PROPENE
    2.994          19.43        105 PROPANE
    3.095           0.64          0
    4.247           0.83          0
    4.973           3.45        110 ISOBUTANE
    5.987           0.57        113 2-METHYL PROPYLENE
    6.335           8.59        115 n-BUTANE
    9.774           4.46        119 ISOPENTANE
   10.173           2.21        123 2-METHYL-1-BUTENE
   10.377           7.42          0
   10.668           5.15        124 n-PENTANE
   11.341           0.22          0
   11.689           0.32          0
   11.773           0.22        395 C5 OLEFIN
   12.147           0.63        396 C5 OLEFIN
   12.260           0.56        135 C6 OLEFIN
   12.413           0.78        136 C6 PARAFFIN
   12.593           0.99        138 CYCLOPENTANE
   12.734           0.36        139 2,3-DIMETHYLBUTANE
   12.922           1.81        141 2-METHYLPENTANE
   13.217           7.62        369 C6 PARAFFIN
   13.373           2.16        145 3-METHYLPENTANE
   13.480           2.42        376 C6 OLEFIN
   13.571           2.79        146 C6 OLEFIN
   13.963           1.97        148 n-HEXANE
   14.171           0.27        150 C7 OLEFIN
   14.763           2.59        156 METHYLCYCLOPENTANE
   15.042           0.39        158 C7 PARAFFIN
   15.261           0.82          0
   15.552           2.37        162 BENZENE
   15.819           1.21        164 CYCLOHEXANE
   16.066           4.89        346 C7 OLEFIN
   16.170           1.97        166 2-METHYLHEXANE
   16.269           0.74        168 C7 PARAFFIN
   16.334           1.94          0
   16.442           1.11        170 3-METHYLHEXANE
   16.522           3.72        347 C7 PARAFFIN
   16.617           1.67        171 C7 PARAFFIN
   16.701           1.06        365 C7 PARAFFIN
   16.787           1.75        172 C7 PARAFFIN
   17.196           1.17        175 n-HEPTANE
   17.805           2.46        179 METHYLCYCLOHEXANE
   17.902           0.56        366 C8 PARAFFIN
   17.964           0.48          0
   18.155           0.52        180 C8 PARAFFIN
   18.419           0.84        182 C8 PARAFFIN
   18.638           2.73        183 C8 PARAFFIN
   18.855           2.17        185 TOLUENE
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                              HP5880A GC Analysis Report

Retention  Concentration
   Time      ppbcarbon          CAL#  Compound


   19.012          0.58          186 C8 PARAFFIN
   19.066          0.15          188 C8 PARAFFIN
   19.177          0.46          189 C8 PARAFFIN
   19.344          0.91          352 C8 PARAFFIN
   19.502          0.93            0
   19.565          4.03          192 C8 PARAFFIN
   19.813          0.47          194 C8 PARAFFIN
   19.901          0.23          353 C8 PARAFFIN
   20.073          0.39          197 C8 PARAFFIN
   20.134          0.49          198 n-OCTANE
   20.675          0.83          202 C9 PARAFFIN
   20.791          2.43          203 C9 OLEFIN
   20.953          0.12          205 C9 PARAFFIN
   21.036          0.13            0
   21.080          0.40          207 C9 PARAFFIN
   21.148          0.47          208 C9 PARAFFIN
   21.233          1.24          209 C9 PARAFFIN
   21.567          0.62          213 ETHYLBENZENE
   21.710          0.35          399 C9 PARAFFIN
   21.800          2.56          215 m&p-XYLENE
   22.047          2.95          217 C9 PARAFFIN
   22.136          3.60          218 C9 PARAFFIN
   22.391          2.81          221 C9 PARAFFIN
   22.567          2.16          224 C9 PARAFFIN
   22.865          0.79          228 n-NONANE
   22.980          0.35          229 C10 PARAFFIN
   23.125          0.41          231 C10 PARAFFIN
   23.450          0.80          234 C10 PARAFFIN
   23.628          0.84          400 C10 PARAFFIN
   23.700          0.52          237 C10 PARAFFIN
   23.836          8.65          239 C10 OLEFIN
   23.997          0.07          241 C10 PARAFFIN
   24.092          0.65          242 n-PROPYLBENZENE
   24.228          0.36          244 p-ETHYLTOLUENE
   24.314          0.63          245 m-ETHYLTOLUENE
   24.423          0.25          246 C9 AROMATIC
   24.477          0.95          247 C10 PARAFFIN
   24.522          0.60          248 C10 PARAFFIN
   24.723          1.47          249 o-ETHYLTOLUENE
   24.928          0.30          251 C10 PARAFFIN
   24.994          1.79          252 C10 OLEFIN
   25.065          1.04          253 1,2,4-TRIMETHYLBENZENE
   25.288          0.98          255 C10 PARAFFIN
   25.365          0.65          256 n-DECANE
   25.755          0.51          260 1,2,3-TRIMETHYLBENZENE
   25.950          0.82          263 C11 PARAFFIN
   26.010          0.80          264 C10 AROMATIC
   26.148          0.37            0
   26.235          0.38          265 C10 AROMATIC
   26.287          0.42            0
   26.437          1.86          267 C10 AROMATIC
   26.565          0.50          268 C10 AROMATIC
   26.884          0.85          273 C11 PARAFFIN
   27.036          0.32          275 C10 AROMATIC
   27.087          0.67          276 1,2-DIMETHYL-4-ETHYLBENZENE
   27.283          0.44          278 C10 AROMATIC
   27.378          8.61          356 C10 AROMATIC
   27.664          0.85          282 1,2-DIMETHYL-3-ETHYLBENZENE
   27.980          0.21          285 1,2,3,5-TETRAMETHYLBENZENE
   28.061          0.63          286 C10 AROMATIC
   28.195          0.58          288 C10 AROMATIC
   28.316          0.41          374 C10 AROMATIC
   28.462          0.25          290 C11 AROMATIC
   28.567          0.74          292 C11 AROMATIC
   28.708          0.36          293 C11 AROMATIC
   28.781          0.10          294 C11 AROMATIC
   28.873          0.33          380 C11 AROMATIC
   28.957          0.71          296 C11 AROMATIC
   29.060          0.39          297 C11 AROMATIC
   29.213          0.30          299 C11 AROMATIC
   29.430          1.06          300 C11 AROMATIC
   29.523          0.03            0
   29.580          0.09          301 C11 AROMATIC
   29.661          0.09          302 C11 AROMATIC
   29.796          1.08          304 C12 PARAFFIN
   29.927          0.08          305 C11 AROMATIC
   30.136          1.07          416 C11 AROMATIC
   30.307          0.18          359 C11 AROMATIC
   30.607          0.17          312 C12 PARAFFIN
   30.747          0.16          314 C12 AROMATIC
   31.248          0.13          319 C12 AROMATIC
   31.329          0.37          320 C12 AROMATIC
   31.782          1.55          323 C12 AROMATIC
   32.081          0.40          326 C12 AROMATIC
   32.188          0.07          327 C12 AROMATIC
   32.563          0.09          331 C12 AROMATIC
   33.067          0.07          410 C12 AROMATIC
   34.800          0.15            0
*** Total ***
                 226.14
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Page No.      1           PROJECT GGC86 - SAMPLE GGC11
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                             HP5880A GC Analysis Report

Retention  Concentration
     Time      ppbcarbon       CAL#  Compound

    1.542           4.39          0
    2.122          27.69          0
    3.152          20.27        105 PROPANE
    3.566           0.15          0
    5.077           4.97        110 ISOBUTANE
    6.087           0.36          0
    6.400          12.02        115 n-BUTANE
    9.295           2.65        119 ISOPENTANE
    9.367           0.05          0
   10.305           1.47        124 n-PENTANE
   10.383           3.23          0
   12.505           0.97        138 CYCLOPENTANE
   12.671           0.86        139 2,3-DIMETHYLBUTANE
   12.877           2.50        141 2-METHYLPENTANE
   13.345           4.60        145 3-METHYLPENTANE
   13.687           3.41          0
   13.982           3.04        148 n-HEXANE
   14.770           3.30        156 METHYLCYCLOPENTANE
   15.068           0.51        158 C7 PARAFFIN
   15.602           3.04        162 BENZENE
   15.838           1.33        163 3,3-DIMETHYLPENTANE
   16.248           2.14        166 2-METHYLHEXANE
   16.510           1.91        170 3-METHYLHEXANE
   16.668           1.70        171 C7 PARAFFIN
   16.750           1.44        365 C7 PARAFFIN
   16.835           2.06        172 C7 PARAFFIN
   17.276           1.45        175 n-HEPTANE
   17.857           2.62        179 METHYLCYCLOHEXANE
   17.967           0.54        366 C8 PARAFFIN
   18.214           0.58        351 C8 OLEFIN
   18.490           0.95        182 C8 PARAFFIN
   18.704           0.95        183 C8 PARAFFIN
   18.940           5.01        185 TOLUENE
   19.272           0.85        189 C8 PARAFFIN
   19.486           0.49        191 C8 PARAFFIN
   19.582           1.38        192 C8 PARAFFIN
   20.148           0.41        197 C8 PARAFFIN
   20.240           0.85        198 n-OCTANE
   20.304           0.58        199 C9 PARAFFIN
   21.147           0.36        207 C9 PARAFFIN
   21.303           0.76        209 C9 PARAFFIN
   21.656           1.36        213 ETHYLBENZENE
   21.897           1.86        215 m&p-XYLENE
   22.223           0.80        218 C9 PARAFFIN
   22.522           1.45        222 o-XYLENE
   22.936           0.35        228 n-NONANE
   23.485           0.32        233 C10 PARAFFIN
   23.844           0.54        238 C10 PARAFFIN
   24.529           1.50        246 C9 AROMATIC
   24.752           0.33        249 o-ETHYLTOLUENE
   25.080           1.12        252 C10 OLEFIN
   25.411           0.32        256 n-DECANE
   25.660           0.15        259 C9 AROMATIC
   25.822           0.27        260 1,2,3-TRIMETHYLBENZENE
   25.990           0.19        262 C11 PARAFFIN
   26.060           0.39        263 C11 PARAFFIN
   27.427           8.23        355 C11 OLEFIN
   29.055           0.49        296 C11 AROMATIC
*** Total ***
                  147.51
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Page No.      1           PROJECT GGC86 - SAMPLE GGC12
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                                  HP5880A GC Analysis Report

Retention  Concentration
     Time      ppbcarbon         CAL#  Compound


    1.563           2.00            0
    1.701           1.40            0
    1.665           8.94            0
    1.964          68.50          103 ACETYLENE
    3.014          51.76          105 PROPANE
    4.992          12.36          110 ISOBUTANE
    6.012           5.53          113 2-METHYL PROPYLENE
    6.344          30.41          115 n-BUTANE
    6.865           0.74            0
    9.281          18.46          119 ISOPENTANE
   10.194           7.90          123 2-METHYL-1-BUTENE
   10.320          12.36          124 n-PENTANE
   11.085           8.88          129 c-2-PENTENE
   11.453           0.13          132 C6 PARAFFIN
   11.545           1.24          133 2,2-DIMETHYLBUTANE
   11.883           2.40          134 C6 OLEFIN
   12.328           0.38          385 C6 PARAFFIN
   12.487           2.75          138 CYCLOPENTANE
   12.635           1.66          139 2,3-DIMETHYLBUTANE
   12.841           7.74          141 2-METHYLPENTANE
   13.156          16.14          369 C6 PARAFFIN
   13.313           9.98          145 3-METHYLPENTANE
   13.386           2.79          376 C6 OLEFIN
   13.937           8.14          148 n-HEXANE
   14.140           0.57          150 C7 OLEFIN
   14.749          10.90          156 METHYLCYCLOPENTANE
   14.959           1.14          157 2,4-DIMETHYLPENTANE
   15.043           0.95          158 C7 PARAFFIN
   15.172           4.44          159 C7 OLEFIN
   15.562           6.73          162 BENZENE
   15.824           5.70          164 CYCLOHEXANE
   15.947         141.80          165 C7 OLEFIN
   16.186          16.60          166 2-METHYLHEXANE
   16.282           4.70            0
   16.335           5.77          168 C7 PARAFFIN
   16.460           5.92          170 3-METHYLHEXANE
   16.534           3.63          347 C7 PARAFFIN
   16.638           4.94          171 C7 PARAFFIN
   16.724           3.96          365 C7 PARAFFIN
   16.810           7.03          172 C7 PARAFFIN
   16.876           1.74          173 2,2,4-TRIMETHYLPENTANE
   17.223           8.09          175 n-HEPTANE
   17.566          16.13          177 C8 OLEFIN
   17.835          11.39          179 METHYLCYCLOHEXANE
   17.932           2.68          366 C8 PARAFFIN
   18.195           2.40          180 C8 PARAFFIN
   18.274           1.21          181 C8 PARAFFIN
   18.455           3.24          182 C8 PARAFFIN
   18.674           6.26          183 C8 PARAFFIN
   18.760           1.05          184 2,3,4-TRIMETHYLPENTANE
   18.894          12.79          185 TOLUENE
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PROJECT GGC86 - SAMPLE GGC12

HP5880A GC Analysis Report

Retention Time	Concentration ppbcarbon	CAL#	Compound
19.062	0.64	187	C8 PARAFFIN
19.115	1.11	188	C8 PARAFFIN
19.223	6.07	189	C8 PARAFFIN
19.380	0.66	352	C8 PARAFFIN
19.445	2.63	191	C8 PARAFFIN
19.550	5.50	192	C8 PARAFFIN
19.606	3.42	0	
19.772	1.50	193	C8 PARAFFIN
19.858	1.63	194	C8 PARAFFIN
19.953	3.06	353	C8 PARAFFIN
20.125	3.41	197	C8 PARAFFIN
20.189	8.96	198	n-OCTANE
20.270	2.28	199	C9 PARAFFIN
20.318	1.66	200	C9 PARAFFIN
20.520	1.32	201	C9 PARAFFIN
20.597	1.07	389	C9 PARAFFIN
20.707	1.60	202	C9 PARAFFIN
20.815	29.34	203	C9 OLEFIN
21.034	3.55	206	C9 PARAFFIN
21.125	2.73	208	C9 PARAFFIN
21.217	0.71	209	C9 PARAFFIN
21.275	5.96	210	C9 PARAFFIN
21.359	0.61	398	C9 PARAFFIN
21.602	4.46	213	ETHYLBENZENE
21.688	1.73	214	C9 PARAFFIN
21.833	14.10	215	m&p-XYLENE
21.980	3.29	216	C9 PARAFFIN
22.070	11.95	367	C9 PARAFFIN
22.178	7.39	218	C9 PARAFFIN
22.327	2.73	220	C9 OLEFIN
22.456	6.45	222	o-XYLENE
22.524	1.36	0	
22.593	4.89	224	C9 PARAFFIN
22.697	1.36	226	C9 PARAFFIN
22.775	1.11	227	C9 PARAFFIN
22.888	5.65	228	n-NONANE
23.020	27.16	229	C10 PARAFFIN
23.146	24.67	231	C10 PARAFFIN
23.473	3.66	234	C10 PARAFFIN
23.640	2.71	400	C10 PARAFFIN
23.730	3.61	237	C10 PARAFFIN
23.804	4.66	238	C10 PARAFFIN
23.863	8.27	239	C10 OLEFIN
24.016	3.27	0	
24.067	2.06	242	n-PROPYLBENZENE
24.245	4.69	244	p-ETHYLTOLUENE
24.314	3.68	245	m-ETHYLTOLUENE
24.438	3.44	246	C9 AROMATIC
24.490	4.34	247	C10 PARAFFIN
24.537	3.59	248	C10 PARAFFIN
24.701	7.45	249	o-ETHYLTOLUENE

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Page No.        3          PROJECT GGC86 - SAMPLE GGC12
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Retention  Concentration
   Time      ppbcarbon         CAL#  Compound


   24.800         1.10            0
   24.858         1.96          250 C9 AROMATIC
   24.927         2.55          251 C10 PARAFFIN
   25.010         2.79          252 C10 OLEFIN
   25.075        11.77          253 1,2,4-TRIMETHYLBENZENE
   25.162         2.98          254 C9 AROMATIC
   25.280        19.25          255 C10 PARAFFIN
   25.375         6.40          256 n-DECANE
   25.433         1.23          257 C9 AROMATIC
   25.631         0.46          259 C9 AROMATIC
   25.675         0.29          408 C9 AROMATIC
   25.768         3.23          260 1,2,3-TRIMETHYLBENZENE
   25.812         9.98          261 C11 PARAFFIN
   25.959         3.51          263 C11 PARAFFIN
   26.107         3.71          264 C10 AROMATIC
   26.244         4.09          265 C10 AROMATIC
   26.356         1.91          266 C10 AROMATIC
   26.492        11.43          401 C10 AROMATIC
   26.566         4.11          268 C10 AROMATIC
   26.682         2.12          269 C10 AROMATIC
   26.735         0.94          271 C11 PARAFFIN
   26.809         1.45          272 C10 AROMATIC
   26.888         3.61          273 C11 PARAFFIN
   26.974         0.65          373 C10 AROMATIC
   27.041         2.43          275 C10 AROMATIC
   27.082         3.78          276 1,2-DIMETHYL-4-ETHYLBENZENE
   27.218         1.53          277 C10 AROMATIC
   27.285         2.62          278 C10 AROMATIC
   27.380        16.67          355 C11 OLEFIN
   27.530         0.10          280 C10 AROMATIC
   27.607         0.31          281 C10 AROMATIC
   27.662         6.17          282 1,2-DIMETHYL-3-ETHYLBENZENE
   27.803         0.39          283 C10 AROMATIC
   27.977         2.53          285 1,2,3,5-TETRAMETHYLBENZENE
   28.081         5.40          287 C11 PARAFFIN
   28.197         2.82          288 C10 AROMATIC
   28.315         1.02          374 C10 AROMATIC
   28.364         1.13          357 C10 AROMATIC
   28.460         2.33          290 C11 AROMATIC
   28.523         3.07          291 C11 AROMATIC
   28.571         5.24          292 C11 AROMATIC
   28.703         3.45          293 C11 AROMATIC
   28.775         0.90          294 C11 AROMATIC
   28.869         1.44          380 C11 AROMATIC
   28.966         2.50          296 C11 AROMATIC
   29.054         2.81          297 C11 AROMATIC
   29.212         1.76          299 C11 AROMATIC
   29.284         0.76          377 C11 AROMATIC
   29.425        10.82          300 C11 AROMATIC
   29.511         0.63            0
   29.562         0.66          301 C11 AROMATIC
   29.657         0.96          302 C11 AROMATIC
   29.733         2.29          303 C11 AROMATIC
   29.791         7.40          304 C12 PARAFFIN
   29.923         1.66          305 C11 AROMATIC
   30.125         5.71          416 C11 AROMATIC
   30.300         1.00          359 C11 AROMATIC
   30.403         0.44          409 C11 AROMATIC
   30.495         0.39          360 C11 AROMATIC
   30.597         0.82          311 C11 AROMATIC
   30.667         0.20          313 C11 AROMATIC
   30.745         0.84          314 C12 AROMATIC
   30.873         3.75          361 C12 AROMATIC
   31.122         2.33          317 C12 AROMATIC
   31.239         0.92          319 C12 AROMATIC
   31.320         4.50          320 C12 AROMATIC
   31.428         2.30          321 C12 AROMATIC
   31.517         0.76          322 C12 AROMATIC
   31.617         0.44          362 C12 AROMATIC
   31.691         1.08          363 C12 AROMATIC
   31.781         7.71          323 C12 AROMATIC
   32.072         1.82          326 C12 AROMATIC
   32.184         1.16          327 C12 AROMATIC
   32.227         0.76          328 C13 PRAFFIN
   32.292         0.66          404 C12 AROMATIC
   32.561         0.18          331 C12 AROMATIC
   32.765         1.58          333 C12 AROMATIC
   32.966         0.73          335 C13 PARAFFIN
   33.054         1.85          336 C12 AROMATIC
   33.243         0.19          381 C12 AROMATIC
   33.334         2.19          337 C12 AROMATIC
   33.428         4.60            0
   33.596         0.66          338 C12 AROMATIC
   33.760         0.69          339 C12 AROMATIC
   33.817         0.85            0
*** Total ***
               1085.79
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Page No.      1          PROJECT GGC86 - SAMPLE GGC13
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Retention  Concentration
   Time       ppbcarbon        CAL#  Compound


    1.899          5.03          0
    1.987         29.17          0
    3.040         31.68        105 PROPANE
    5.007          8.26        110 ISOBUTANE
    6.028          1.45        113 2-METHYL PROPYLENE
    6.354         22.48        115 n-BUTANE
    7.700          0.46          0
    9.280         15.02        119 ISOPENTANE
    9.917          0.15        121 1-PENTENE
   10.172          1.14        123 2-METHYL-1-BUTENE
   10.298         13.57        124 n-PENTANE
   10.654          0.20        126 t-2-PENTENE
   11.065          1.06        129 c-2-PENTENE
   11.433          0.12        132 C6 PARAFFIN
   11.521          0.36        133 2,2-DIMETHYLBUTANE
   12.336          0.23        136 C6 PARAFFIN
   12.456          2.40        138 CYCLOPENTANE
   12.530          0.24          0
   12.600          1.41        139 2,3-DIMETHYLBUTANE
   12.798          7.11        141 2-METHYLPENTANE
   13.041          0.15        407 C6 PARAFFIN
   13.130          8.69        369 C6 PARAFFIN
   13.276          8.00        145 3-METHYLPENTANE
   13.522          1.74        344 C6 OLEFIN
   13.897          8.22        148 n-HEXANE
   14.156          0.35        151 C7 OLEFIN
   14.720          9.98        156 METHYLCYCLOPENTANE
   14.922          0.68        157 2,4-DIMETHYLPENTANE
   15.013          0.81        158 C7 PARAFFIN
   15.317          0.82        415 C7 OLEFIN
   15.528          4.46        162 BENZENE
   15.802          5.03        164 CYCLOHEXANE
   16.163          8.08        166 2-METHYLHEXANE
   16.263          1.17        168 C7 PARAFFIN
   16.435          4.48        170 3-METHYLHEXANE
   16.542          1.25        347 C7 PARAFFIN
   16.612          4.26        171 C7 PARAFFIN
   16.700          3.59        365 C7 PARAFFIN
   16.787          6.94        172 C7 PARAFFIN
   16.852          1.86        173 2,2,4-TRIMETHYLPENTANE
   17.202          8.61        175 n-HEPTANE
   17.516          0.76        177 C8 OLEFIN
   17.580          2.28        178 C8 OLEFIN
   17.815         10.28        179 METHYLCYCLOHEXANE
   17.914          1.77        366 C8 PARAFFIN
   18.177          2.50        180 C8 PARAFFIN
   18.257          1.01        181 C8 PARAFFIN
   18.439          2.90        182 C8 PARAFFIN
   18.659          4.34        183 C8 PARAFFIN
   18.742          1.22        184 2,3,4-TRIMETHYLPENTANE
   18.879         10.90        185 TOLUENE
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Page No.      2             PROJECT GGC86 - SAMPLE GGC13
08/04/86
                             HP5880A GC Analysis Report

Retention  Concentration
     Time      ppbcarbon        CAL#  Compound


   19.050           0.70         187 C8 PARAFFIN
   19.103           1.04         188 C8 PARAFFIN
   19.210           6.51         189 C8 PARAFFIN
   19.433           2.88         191 C8 PARAFFIN
   19.539           5.07         192 C8 PARAFFIN
   19.610           3.27           0
   19.760           1.12         193 C8 PARAFFIN
   19.847           1.27         194 C8 PARAFFIN
   19.942           2.56         353 C8 PARAFFIN
   20.114           2.61         197 C3 PARAFFIN
   20.181           7.97         198 n-OCTANE
   20.260           2.09         199 C9 PARAFFIN
   20.311           1.40         200 C9 PARAFFIN
   20.509           0.99         201 C9 PARAFFIN
   20.677           0.43         202 C9 PARAFFIN
   20.818           6.18         203 C9 OLEFIN
   21.028           3.99         206 C9 PARAFFIN
   21.117           3.03         208 C9 PARAFFIN
   21.267           8.05         210 C9 PARAFFIN
   21.360           1.03         211 C9 PARAFFIN
   21.434           1.13         212 C9 PARAFFIN
   21.597           5.85         213 ETHYLBENZENE
   21.685           1.75         214 C9 PARAFFIN
   21.830          14.72         215 m&p-XYLENE
   21.984           2.94         216 C9 PARAFFIN
   22.072           3.85         217 C9 PARAFFIN
   22.174           5.55         218 C9 PARAFFIN
   22.327           1.98         220 C9 OLEFIN
   22.456           6.95         222 o-XYLENE
   22.521           0.74         223 C9 PARAFFIN
   22.595           4.34         224 C9 PARAFFIN
   22.695           0.95         226 C9 PARAFFIN
   22.771           0.59         227 C9 PARAFFIN
   22.887           6.54         228 n-NONANE
   23.016           1.24         229 C10 PARAFFIN
   23.075           0.51         230 C10 PARAFFIN
   23.150           2.36         231 C10 PARAFFIN
   23.305           0.40         232 C10 PARAFFIN
   23.470           3.44         234 C10 PARAFFIN
   23.635           2.69         400 C10 PARAFFIN
   23.727           2.68         237 C10 PARAFFIN
   23.804           4.02         238 C10 PARAFFIN
   23.841           5.11           0
   23.884           4.35         239 C10 OLEFIN
   24.017           2.57         241 C10 PARAFFIN
   24.066           2.47         242 n-PROPYLBENZENE
   24.243           4.21         244 p-ETHYLTOLUENE
   24.309           3.40         245 m-ETHYLTOLUENE
   24.436           2.89         246 C9 AROMATIC
   24.492           4.18         247 C10 PARAFFIN
   24.537           3.57         248 C10 PARAFFIN
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08/04/86              PROJECT GGC86 - SAMPLE GGC13

                         HP5880A GC Analysis Report

Retention  Concentration
     Time      ppbcarbon        CAL#  Compound


   24.706           5.54         249 o-ETHYLTOLUENE
   24.862           2.96         250 C9 AROMATIC
   24.927           2.19         251 C10 PARAFFIN
   25.003           3.95         252 C10 OLEFIN
   25.075           9.75         253 1,2,4-TRIMETHYLBENZENE
   25.162           2.42         254 C9 AROMATIC
   25.280           5.14         255 C10 PARAFFIN
   25.373           7.45         256 n-DECANE
   25.435           1.20         257 C9 AROMATIC
   25.513           1.70         258 C9 AROMATIC
   25.629           1.18         259 C9 AROMATIC
   25.765           6.52         260 1,2,3-TRIMETHYLBENZENE
   25.812          10.13         261 C11 PARAFFIN
   25.957           5.65         263 C11 PARAFFIN
   26.074           1.82         264 C10 AROMATIC
   26.121           2.33           0
   26.245           4.86         265 C10 AROMATIC
   26.356           1.97         266 C10 AROMATIC
   26.429           3.49         267 C10 AROMATIC
   26.567           6.66         268 C10 AROMATIC
   26.682           2.46         270 C10 AROMATIC
   26.734           0.84         271 C11 PARAFFIN
   26.809           1.39         272 C10 AROMATIC
   26.888           3.03         273 C11 PARAFFIN
   26.977           0.65         373 C10 AROMATIC
   27.037           2.00         275 C10 AROMATIC
   27.082           3.26         276 1,2-DIMETHYL-4-ETHYLBENZENE
   27.216           1.43         277 C10 AROMATIC
   27.284           2.10         278 C10 AROMATIC
   27.373          17.85         355 C11 OLEFIN
   27.607           0.40         281 C10 AROMATIC
   27.662           7.67         282 1,2-DIMETHYL-3-ETHYLBENZENE
   27.807           0.45         283 C10 AROMATIC
   27.897           0.51         284 1,2,4,5-TETRAMETHYLBENZENE
   27.971           2.11         285 1,2,3,5-TETRAMETHYLBENZENE
   28.054           4.10         286 C10 AROMATIC
   28.196           2.72         288 C10 AROMATIC
   28.315           1.11         374 C10 AROMATIC
   28.362           0.99         357 C10 AROMATIC
   28.461           2.55         290 C11 AROMATIC
   28.515           1.43         291 C11 AROMATIC
   28.574           5.50         292 C11 AROMATIC
   28.705           3.49         293 C11 AROMATIC
   28.775           1.87         294 C11 AROMATIC
   28.867           3.52         380 C11 AROMATIC
   28.967           2.26         296 C11 AROMATIC
   29.054           3.02         297 C11 AROMATIC
   29.207           1.52         299 C11 AROMATIC
   29.286           0.73         377 C11 AROMATIC
   29.426           7.48         300 C11 AROMATIC
   29.510           1.34           0
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Page No.      4          PROJECT GGC86 - SAMPLE GGC13
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Retention  Concentration
     Time      ppbcarbon       CAL#  Compound


    29.562          1.66        301 C11 AROMATIC
    29.658          2.73          0
    29.732          3.14        303 C11 AROMATIC
    29.789          8.73        304 C12 PARAFFIN
    29.921          1.83        305 C11 AROMATIC
    30.000          0.55        306 C11 AROMATIC
    30.123          6.01        416 C11 AROMATIC
    30.300          1.01        359 C11 AROMATIC
    30.407          0.40        409 C11 AROMATIC
    30.495          0.42        360 C11 AROMATIC
    30.598          1.04        311 C11 AROMATIC
    30.669          0.15        313 C11 AROMATIC
    30.745          1.00        314 C12 AROMATIC
    30.829          2.26        361 C12 AROMATIC
    31.114          2.31        317 C12 AROMATIC
    31.238          0.97        319 C12 AROMATIC
    31.321          4.97        320 C12 AROMATIC
    31.427          2.75        321 C12 AROMATIC
    31.613          0.46        362 C12 AROMATIC
    31.690          1.22        363 C12 AROMATIC
    31.784          7.68        323 C12 AROMATIC
    31.911          1.40        325 C12 AROMATIC
    32.074          1.70        326 C12 AROMATIC
    32.190          0.25        327 C12 AROMATIC
    32.290          0.19        404 C12 AROMATIC
    32.461          0.36        330 C12 AROMATIC
    32.560          0.57        331 C12 AROMATIC
    32.647          0.41        332 C12 AROMATIC
    32.767          1.54        333 C12 AROMATIC
    32.971          0.79        335 C13 PARAFFIN
    33.053          1.88        336 C12 AROMATIC
    33.247          0.21        381 C12 AROMATIC
    33.341          0.47        337 C12 AROMATIC
    33.431          2.26          0
    33.601          0.53          0
    33.70[illegible]          0.29        339 C12 AROMATIC
    33.767          0.20          0
    33.822          0.80          0
*** Total ***
                  680.66
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Page No.       1             PROJECT GGC86 - SAMPLE GGC15
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                               HP5880A GC Analysis Report

Retention  Concentration
     Time      ppbcarbon       CAL#  Compound


    1.870           3.01          0
    1.920           3.51          0
    1.979          40.11          0
    3.051          37.96        105 PROPANE
    4.418           0.21          0
    5.012           9.20        110 ISOBUTANE
    6.040           1.39          0
    6.357          25.18        115 n-BUTANE
    9.282          13.57        119 ISOPENTANE
   10.305          15.30        124 n-PENTANE
   10.481           0.22        125 ISOPRENE
   11.070           0.43        129 c-2-PENTENE
   11.433           0.12        132 C6 PARAFFIN
   11.522           0.47        133 2,2-DIMETHYLBUTANE
   11.832           0.04        134 C6 OLEFIN
   12.447           1.96        138 CYCLOPENTANE
   12.589           1.43        139 2,3-DIMETHYLBUTANE
   12.790           5.61        141 2-METHYLPENTANE
   13.180           3.78        144 C6 OLEFIN
   13.267           5.78        145 3-METHYLPENTANE
   13.520           6.23        344 C6 OLEFIN
   13.740           0.54        147 C6 OLEFIN
   13.891           5.92        148 n-HEXANE
   14.710           9.18        156 METHYLCYCLOPENTANE
   14.929           0.50        157 2,4-DIMETHYLPENTANE
   15.003           0.30        158 C7 PARAFFIN
   15.265           0.77        415 C7 OLEFIN
   15.532           4.18        162 BENZENE
   15.790           4.95        164 CYCLOHEXANE
   16.055           1.15        346 C7 OLEFIN
   16.200           4.86        167 2,3-DIMETHYLPENTANE
   16.254           1.71        168 C7 PARAFFIN
   16.437           4.58        170 3-METHYLHEXANE
   16.607           8.71        171 C7 PARAFFIN
   16.694           4.97        365 C7 PARAFFIN
   16.781           6.37        172 C7 PARAFFIN
   17.209           3.18        175 n-HEPTANE
   17.528           1.30        177 C8 OLEFIN
   17.813           9.03        179 METHYLCYCLOHEXANE
   17.914           2.13        366 C8 PARAFFIN
   18.175           2.05        180 C8 PARAFFIN
   18.262           0.80        181 C8 PARAFFIN
   18.439           3.65        182 C8 PARAFFIN
   18.657           5.19        183 C8 PARAFFIN
   18.742           2.15        184 2,3,4-TRIMETHYLPENTANE
   18.891           6.14        185 TOLUENE
   19.105           1.14        188 C8 PARAFFIN
   19.220           2.54        189 C8 PARAFFIN
   19.447           2.25        191 C8 PARAFFIN
   19.540           4.96          0
   19.591           1.21        192 C8 PARAFFIN
```

08/04/86

PROJECT GGC86 - SAMPLE GGC15

HP5880A GC Analysis Report

Retention Time	Concentration ppbcarbon	CAL#	Compound
19.663	4.14	0	
19.844	0.76	194	C8 PARAFFIN
19.943	2.13	353	C8 PARAFFIN
20.115	2.31	197	C8 PARAFFIN
20.190	1.66	198	n-OCTANE
20.263	2.42	199	C9 PARAFFIN
20.309	0.79	200	C9 PARAFFIN
20.512	0.99	201	C9 PARAFFIN
20.680	0.32	202	C9 PARAFFIN
20.838	4.98	203	C9 OLEFIN
20.987	0.40	205	C9 PARAFFIN
21.038	1.15	206	C9 PARAFFIN
21.113	2.15	207	C9 PARAFFIN
21.270	4.02	209	C9 PARAFFIN
21.357	0.73	398	C9 PARAFFIN
21.610	3.50	213	ETHYLBENZENE
21.688	1.37	214	C9 PARAFFIN
21.788	0.74	399	C9 PARAFFIN
21.855	3.83	215	m&p-XYLENE
22.055	0.20	367	C9 PARAFFIN
22.116	1.23	217	C9 PARAFFIN
22.200	4.33	218	C9 PARAFFIN
22.457	5.27	222	o-XYLENE
22.605	3.24	224	C9 PARAFFIN
22.695	2.02	225	C9 PARAFFIN
22.900	0.83	228	n-NONANE
23.023	0.75	229	C10 PARAFFIN
23.157	1.68	231	C10 PARAFFIN
23.471	2.19	234	C10 PARAFFIN
23.730	0.88	236	C10 PARAFFIN
23.815	1.75	238	C10 PARAFFIN
23.878	5.62	239	C10 OLEFIN
24.021	1.36	240	C10 OLEFIN
24.134	1.10	242	n-PROPYLBENZENE
24.263	1.00	244	p-ETHYLTOLUENE
24.343	1.67	245	m-ETHYLTOLUENE
24.498	1.98	247	C10 PARAFFIN
24.548	1.10	248	C10 PARAFFIN
24.750	1.06	249	o-ETHYLTOLUENE
24.863	0.29	250	C9 AROMATIC
25.022	3.04	252	C10 OLEFIN
25.095	1.69	253	1,2,4-TRIMETHYLBENZENE
25.175	0.93	254	C9 AROMATIC
25.290	9.37	255	C10 PARAFFIN
25.384	0.76	256	n-DECANE
25.635	0.98	259	C9 AROMATIC
25.700	0.56	408	C9 AROMATIC
25.822	7.75	261	C11 PARAFFIN
25.967	1.15	263	C11 PARAFFIN
26.021	0.46	0	
26.123	0.62	264	C10 AROMATIC

```
Page No.      3           PROJECT GGC86 - SAMPLE GGC15
08/04/86
                            HP5880A GC Analysis Report

Retention  Concentration
     Time      ppbcarbon        CAL#  Compound

  26.448            0.85         267 C10 AROMATIC
  26.505            0.22         401 C10 AROMATIC
  26.587            0.35         268 C10 AROMATIC
  26.688            0.33         269 C10 AROMATIC
  26.895            0.78         273 C11 PARAFFIN
  27.073            2.27         275 C10 AROMATIC
  27.243            0.16         277 C10 AROMATIC
  27.296            0.92         278 C10 AROMATIC
  27.386           16.21         355 C11 OLEFIN
  27.673            1.52         282 1,2-DIMETHYL-3-ETHYLBENZENE
  27.993            0.78         285 1,2,3,5-TETRAMETHYLBENZENE
  28.070            1.51         286 C10 AROMATIC
  28.202            0.61         288 C10 AROMATIC
  28.578            0.78         292 C11 AROMATIC
  28.721            0.73         293 C11 AROMATIC
  28.793            0.28         294 C11 AROMATIC
  28.873            0.35         370 C10 AROMATIC
  28.968            0.23         296 C11 AROMATIC
  29.057            0.55         297 C11 AROMATIC
  29.217            0.24         299 C11 AROMATIC
  29.290            0.23         377 C11 AROMATIC
  29.447            1.08         300 C11 AROMATIC
  29.667            0.08         302 C11 AROMATIC
  29.796            1.26         304 C12 PARAFFIN
  29.929            0.14         305 C11 AROMATIC
  30.000            0.32         306 C11 AROMATIC
  30.134            1.62         416 C11 AROMATIC
  30.317            0.34         359 C11 AROMATIC
  30.414            0.25         409 C11 AROMATIC
  30.603            0.31         311 C11 AROMATIC
  30.847            0.07         361 C12 AROMATIC
  30.990            0.21         315 C12 AROMATIC
  31.047            0.05         316 C12 AROMATIC
  31.247            0.15         319 C12 AROMATIC
  31.323            1.27         320 C12 AROMATIC
  31.433            0.40           0
  31.528            0.15         322 C12 AROMATIC
  31.620            0.08         362 C12 AROMATIC
  31.699            0.28           0
  31.785            2.69         323 C12 AROMATIC
  31.887            0.16         324 C12 AROMATIC
  31.990            0.08         325 C12 AROMATIC
  32.088            0.29         326 C12 AROMATIC
  32.183            0.41           0
  32.240            0.12         328 C13 PRAFFIN
  32.297            0.12         404 C12 AROMATIC
  32.463            0.19         330 C12 AROMATIC
  32.563            0.31         331 C12 AROMATIC
  32.773            0.42         333 C12 AROMATIC
  33.055            0.86         336 C12 AROMATIC
  33.167            0.12         410 C12 AROMATIC
  33.243            0.16         381 C12 AROMATIC
  33.315            2.34         337 C12 AROMATIC
  33.421            3.73           0
  33.594            0.75           0
  33.706            3.45         339 C12 AROMATIC
  34.797            0.56           0
  35.583            0.30         406 C12 AROMATIC
*** Total ***
                  442.19
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A-7.0. DESCRIPTION OF THE GGC REMOTE VAPOR SAMPLER (RVS)

The features of this system include the following:

- o Samplers are light weight to facilitate transport and use on towers.
- o Samplers are individually or simultaneously controllable (as many as 12 sets of samplers can be turned on and off individually).
- o Samplers are completely battery operated.
- o Pump flow rate is adjustable from less than 50 to greater than 500 cc/min.
- o Samplers are suitable for adsorbent tube sampling or bag filling.

The GGC designed RVS system consists of two basic components, a hand held transmitter and multiple tripod mounted receivers. Each receiver is wired to a variable flow rate sampling pump which can be operated either manually or by remote control.

Transmitter - The transmitter consists of a tone generation circuit and a RF section. A block diagram of the transmitter is shown below in Figure A-8. The transmitter has a keypad of pushbutton switches arranged in a 4 x 4 array as shown Figure A-9. The "ALL ON" and "ALL OFF" switches are used to turn all the remote vapor samplers on or off simultaneously. All of the receivers in the RVSs are activated by depressing the "ALL ON" or "ALL OFF" switch for 3 seconds. The "ON" and "OFF" switches are used in conjunction with the numerically labeled switches to turn each RVS on or off individually. To activate a specific RVS its numbered transmitter button is depressed for 3 seconds followed by depressing the desired "ON" or "OFF" function for 3 seconds.

Receiver - The receiver is a narrow band dual conversion design which includes the DTMF decoder and sixteen line drives on one circuit board. The receiver consists of the RF/IF section, frequency synthesized local oscillator, FM receiver/demodulator, DTMF decoder and sixteen output drivers. Block diagrams for the receiver RF/IF section and receiver decoder section are shown in Figures A-10 and A-11 respectively.

Each RVS box is self-contained except for an external 12 volt rechargeable battery. Figure A-12 is a diagram of a typical RVS showing locations of external and internal components. The RVS and batteries are typically mounted on camera tripods such that the sample tube inlet is approximately 5' and the antenna is approximately 10' above ground level. Prior to deployment, each RVS is given a channel number by depressing one of twelve dip switches (located inside the RVS box) to the on position. Depending on sampling requirements, one or multiple RVSs can be tuned to operate on the same channel. After the channel has been set, the pump flow rate is adjusted by means of an external trim potentiometer. Depending on the type of adsorbent tube used, the flow rate can be adjusted from less than 50 cc/min to greater than 500 cc/min. One transmitter plus ten fully operational samplers costs approximately $4000.

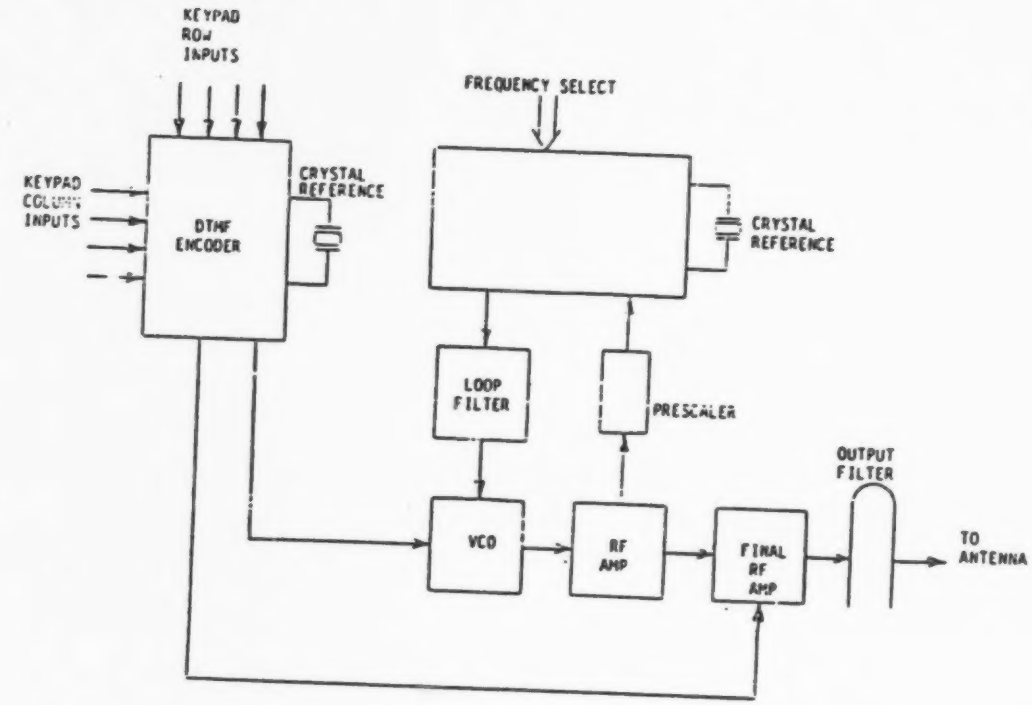

KEYPAD
ROW
INPUTS
FREQUENCY SELECT
KEYPAD
COLUMN
INPUTS
DTMF
ENCODER
CRYSTAL
REFERENCE
CRYSTAL
REFERENCE
LOOP
FILTER
PRESCALER
OUTPUT
FILTER
VCO
RF
AMP
FINAL
RF
AMP
TO
ANTENNA

Figure A-8. Transmitter Block Diagram

REMCON RECEIVER DECODER
OPERATING INSTRUCTIONS

THE RECEIVER DECODER BOX IS DESIGNED TO BE OPERATED IN CONJUNCTION WITH THE REMCON TRANSMITTER. AS A SIMPLE PUMP CONTROLLER, HOWEVER, IT CAN BE USED IN A STANDALONE MANUAL MODE.

TRANSMITTER

THE TRANSMITTER KEYPAD CONSISTS OF A 4 X 4 ARRAY OF PUSHBUTTON SWITCHES. THE SWITCHES AND LABELING ARE SHOWN BELOW:

Figure A-9.

ALL ON	ON	3	4
5	6	7	8
9	10	11	12
13	14	OFF	ALL OFF

THE "ALL ON" AND "ALL OFF" SWITCHES ARE USED TO TURN ALL OF THE REMOTE RECEIVER BOXES ON OR OFF SIMULTANEOUSLY. DEPRESS THE SWITCH AND HOLD IT FOR APPROXIMATELY THREE SECONDS.

THE "ON" AND "OFF" SWITCHES ARE USED IN CONJUNCTION WITH THE NUMERICALLY LABELED SWITCHES TO TURN THE REMOTE RECEIVERS ON OR OFF INDIVIDUALLY. DEPRESS THE DESIRED RECEIVER CHANNEL NUMBER SWITCH AND HOLD FOR APPROXIMATELY THREE SECONDS, THEN DEPRESS THE DESIRED FUNCTION (ON OR OFF) SWITCH AND HOLD FOR APPROXIMATELY THREE SECONDS.

IF SEVERAL (UP TO FOUR) INDIVIDUAL RECEIVERS ARE TO BE TURNED ON OR OFF SIMULTANEOUSLY, SIMPLY KEY IN ALL OF THE DESIRED RECEIVER NUMBERS AND THEN KEY IN THE DESIRED "ON" OR "OFF" FUNCTION. (NOTE: SINCE A ONE-SHOT TIMER IS ACTIVATED IN THE RECEIVER WHENEVER A NUMERICALLY LABELED SWITCH IS DEPRESSED, A WAIT OF AT LEAST 20 SECONDS IS REQUIRED BETWEEN RECEIVER ON (OFF) COMMANDS AND A RECEIVER OFF (ON) COMMAND).

RECEIVER

EACH RECEIVER BOX IS SELF-CONTAINED EXCEPT FOR AN EXTERNAL 8 TO 15 VOLT BATTERY. BATTERY CONNECTIONS ARE MADE VIA A POLARIZED CABLE: ONE END CONNECTS TO THE RECEIVER BOX, THE OTHER END HAS ALLIGATOR CLIPS TO CONNECT TO THE BATTERY TERMINALS (RED CONNECTS TO BATTERY ⊕, BLACK TO BATTERY ⊖).

PRIOR TO CONNECTING THE BATTERY, IT IS NECESSARY TO SET UP THE RECEIVER CHANNEL FOR THE PARTICULAR BOX BEING USED. UP TO 12 INDIVIDUAL CHANNELS ARE SELECTABLE (CHANNELS 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13 OR 14). REMOVE THE COVER OF THE DECODER BOX TO REVEAL TWO DIP SWITCH ASSEMBLIES. ORIENT THE BOX SO THAT THE DIP SWITCHES ARE TO YOUR LEFT, WITH THE RECEIVER PCB FARTHEST FROM YOU (SEE DIAGRAM). THE SWITCH ASSOCIATED WITH EACH CHANNEL IS SHOWN IN THE DIAGRAM. PLACE THE SWITCH FOR THE DESIRED CHANNEL IN THE "ON" POSITION. ALL OTHER SWITCHES MUST BE IN THE "OFF" POSITION. ADDITIONALLY, THE SWITCHES LABELED "CHANNEL 2/ON" AND "CHANNEL 15/OFF" MUST ALWAYS BE IN THE "OFF" POSITION. (NOTE: ANY BOX CAN BE CONFIGURED TO RESPOND TO ANY NUMBER OF CHANNELS BY PLACING ALL OF THE DESIRED CHANNEL SWITCHES IN THE "ON" POSITION).

CAREFULLY REPLACE THE COVER ON THE BOX.

THE FLOW RATE FOR THE PUMP IS ADJUSTED BY MEANS OF A TRIM POTENTIOMETER. THIS POTENTIOMETER IS EXTERNAL ON MOST MODELS, INTERNAL ON A FEW.

THE FLOW RATE IS MEASURED DIRECTLY USING A FLOWMETER, AND THE POT IS ADJUSTED UNTIL THE DESIRED FLOW RATE IS ACHIEVED. NOTE THAT POWER MUST BE APPLIED TO THE SYSTEM AND THE PUMP MUST BE TURNED ON (THE "MANUAL ON" PUSHBUTTON SWITCH FACILITATES THIS OPERATION). AN ALTERNATE METHOD IF A FLOWMETER IS UNAVAILABLE IS TO MEASURE THE VOLTAGE ACROSS THE PUMP MOTOR AND, USING THE ATTACHED CHART OF FLOW RATE VS. VOLTAGE, ADJUST THE VOLTAGE TO THE CORRECT VALUE.

IF THE INTERNAL POT WAS ADJUSTED, REMOVE POWER AND CAREFULLY REINSTALL THE COVER.

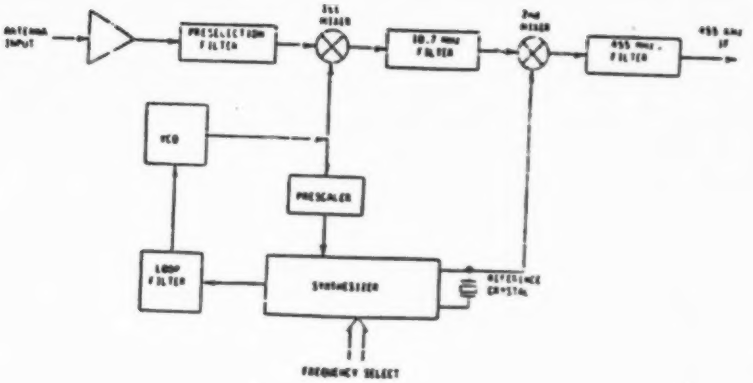

ANTENNA INPUT
PRESELECTION FILTER
1st MIXER
10.7 MHz FILTER
2nd MIXER
455 KHz FILTER
455 KHz IF
VCO
PRESCALER
LOOP FILTER
SYNTHESIZER
REFERENCE CRYSTAL
FREQUENCY SELECT

Figure A-10 Receiver RF/IF Block Diagram

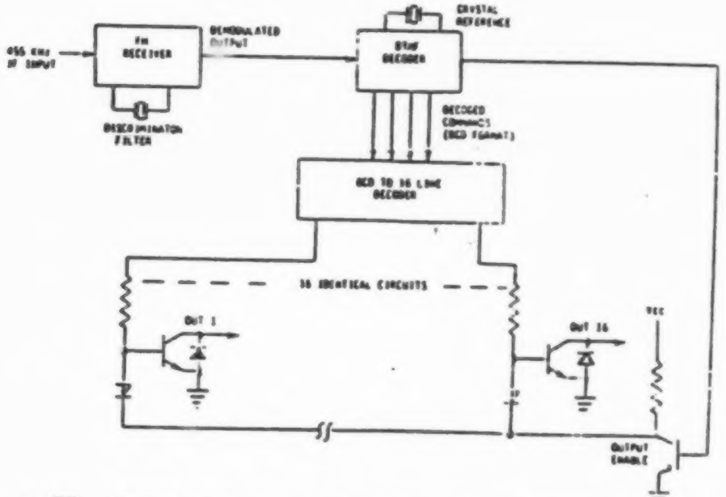
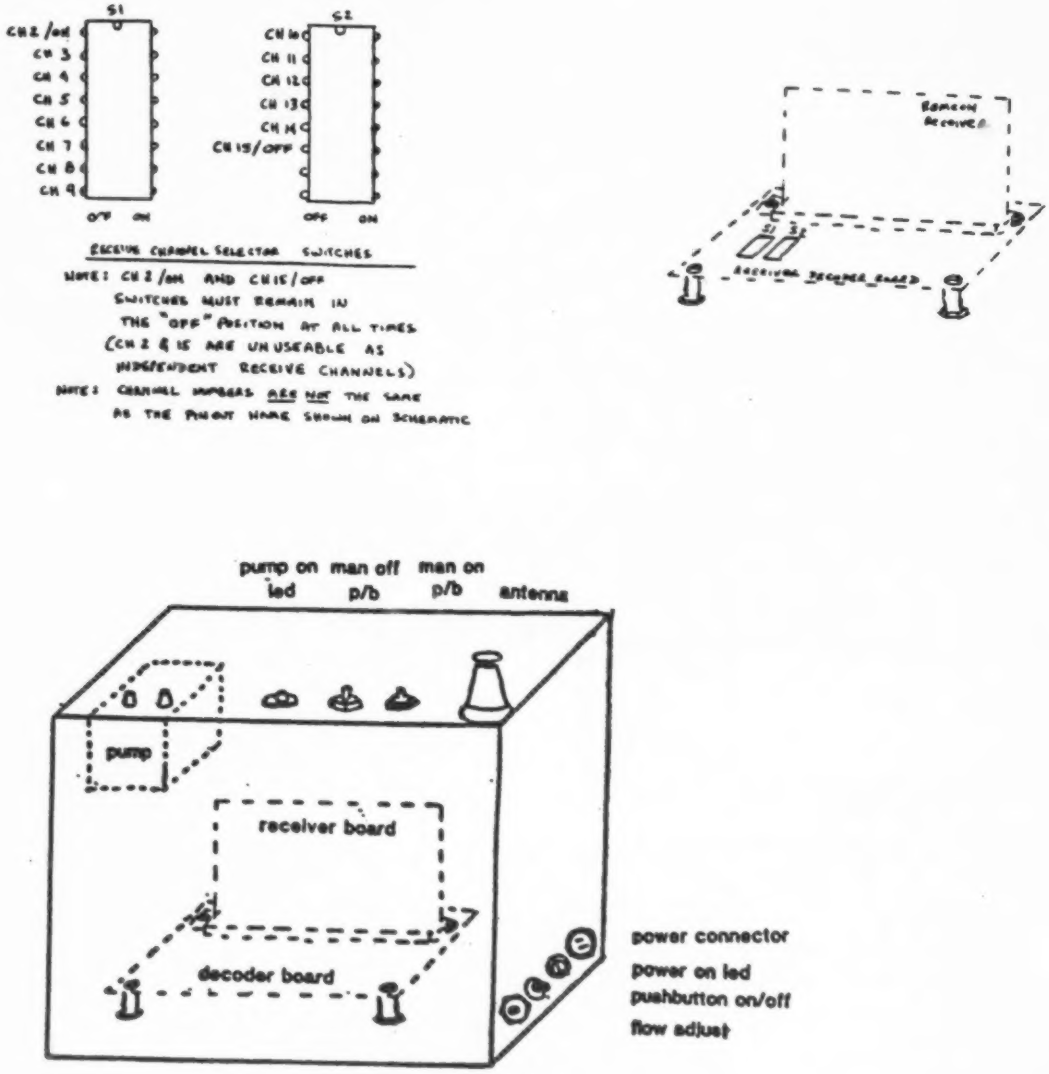

455 KHz IF INPUT
FM RECEIVER
DEMODULATED OUTPUT
DISCRIMINATOR FILTER
DTMF DECODER
CRYSTAL REFERENCE
DECODED COMMANDS (BCD FORMAT)
BCD TO 16 LINE DECODER
16 IDENTICAL CIRCUITS
OUT 1
OUT 16
VCC
OUTPUT ENABLE

Figure A-11 Receiver Decoder Block Diagram


S1
CH 2/ON
CH 3
CH 4
CH 5
CH 6
CH 7
CH 8
CH 9
OFF
ON
S2
CH 10
CH 11
CH 12
CH 13
CH 14
CH 15/OFF
OFF
ON
S1
S2
pump on led
man off p/b
man on p/b
antenna
pump
receiver board
decoder board
power connector
power on led
pushbutton on/off
flow adjust

RECEIVE CHANNEL SELECTOR SWITCHES

NOTE: CH 2/ON AND CH 15/OFF SWITCHES MUST REMAIN IN THE "OFF" POSITION AT ALL TIMES (CH 2 & 15 ARE UNUSEABLE AS INDEPENDENT RECEIVE CHANNELS)

NOTE: CHANNEL NUMBERS ARE NOT THE SAME AS THE PINOUT NAME SHOWN ON SCHEMATIC

Figure A-12 Schematic of RVS showing external and internal components including pushbutton switches (p/b), light emitting diodes (led), pump, and electronic circuit boards. Weight = 1#; dimensions = 6"(w)x4"(D)x5"(H).

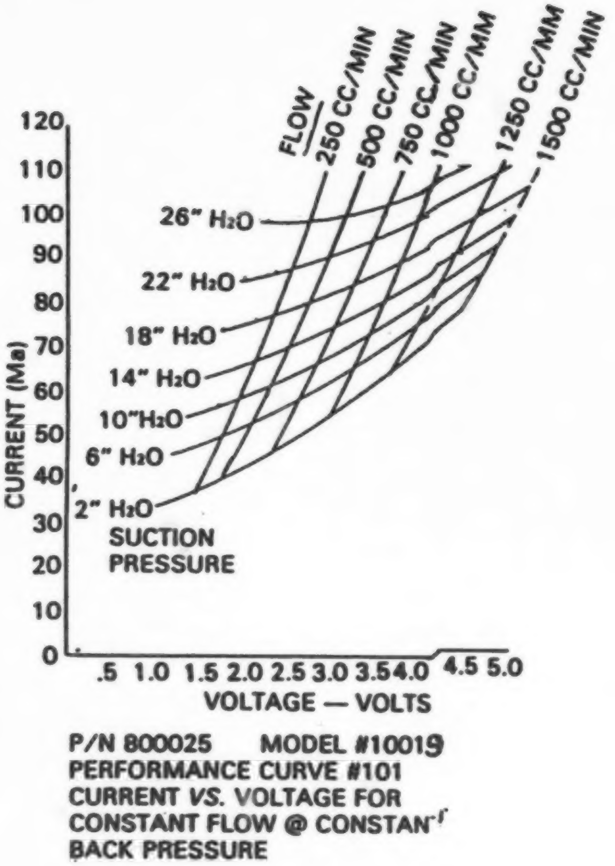


Figure A-13. Flow rate Chart for Gillian Model 10019 instrument pump.

APPENDIX B

Summary of Data on Hazardous Air Pollutants

Table B-1. Organic Functional Groups

1---HYDROCARBONS
1.1-Saturated aliphatics
1.2-Cylics
1.3-Unsaturated aliphatics
1.4-Dienes
1.5-Terpenes
1.6-Aromatics
1.7-Polycylcic aromatics
1.8-Miscellaneous

2---HALOGENATED HYDROCARBONS
2.1-Solvents
2.2-Pesticides
2.3-Pesticide Metabolites
2.4-Miscellaneous

3---ALCOHOLS
3.1-Aliphatics
3.2-Aromatics
3.3-Halogenated
3.4-Substituted
3.5-Quinones
3.6-Miscellaneous

4---ETHERS
4.1-Aliphatic
4.2-Epoxides
4.3-Cyclics
4.4-Oxiranes and other reactive species
4.5-Chloromethyl Ethers
4.6-Miscellaneous

5---CARBONYL COMPOUNDS
5.1-Aldehydes
5.2-Ketones
5.3-Unsaturated aldehydes
5.4-Unsaturated ketones
5.6-Miscellaneous

6---CARBOXYLIC ACIDS AND THEIR DERIVATIVES
6.1-Acids
6.2-Anhydrides
6.3-Esters
6.4-Nitriles
6.5-Amides
6.6-Peroxycarboxyl Nitrates
6.7-Miscellaneous

7---NITROGEN COMPOUNDS
7.1-Amines
7.2-Nitro compounds
7.3-Hydrazine derivatives
7.4-Azo compounds
7.5-Amine oxides
7.6-N-nitroso compounds
7.7-Nitrogen heterocycles
7.8-Amino alcohols
7.9-Miscellaneous

8---SULPHUR COMPOUNDS
8.1-Thiols and Mercaptans
8.2-Thioesters
8.3-Disulfides
8.4-Sulfones
8.5-Sulfoxides
8.6-Miscellaneous

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Table B-2. Carcinogenicity Mutagenicity Information for 44 HAPS (arranged alphabetically)

CAS NO.		Compound	Function	MW	Formula
75-07-0	A *	ACETALDEHYDE (ETHANAL)	5.1	44.05	C2H4O
107-02-8	C *	ACROLEIN (PROPENAL)	5.3	56.06	C3H4O
107-13-1	W*	ACRYLONITRILE (2-PROPENENITRILE)	6.4	53.04	C3H3N
107-05-1	E	ALLYL CHLORIDE(3-CHLOROPROPENE)	2.4	76.53	C3H5CL
62-53-3	E *	ANILINE (AMINOBENZENE)	7.1	93.11	C6H7N
71-43-2	W*	BENZENE	1.6	78.11	C6H6
100-44-7	E *	BENZYL CHLORIDE (A-CHLOROTOLUENE)	2.4	126.59	C7H7CL
56-23-5	W*	CARBON TETRACHLORIDE(TETRACHLOROMETHANE)	2.1	153.82	CCL4
108-90-7	A *	CHLOROBENZENE	2.4	112.56	C6H5CL
67-66-3	W*	CHLOROFORM (TRICHLOROMETHANE)	2.1	119.38	CHCL3
542-88-1	W*	CHLOROMETHYL ETHER(1,1'-DICHLOROMETHYL E	4.5	114.96	C2H4CL2O
126-99-8	A	CHLOROPRENE (2-CHLOROBUTADIENE)	2.4	88.54	C4H5CL
108-39-4	C *	CRESOL(META) (3-METHYLPHENOL)	3.2	108.40	C7H8O
106-46-7	A *	DICHLOROBENZENE(PARA) (1,4-DICHLOROBENZE	2.4	147.01	C6H4CL2
75-34-3	A	DICHLOROETHANE(1,1)	2.1	98.96	C2H4CL2
540-59-0	A *	DICHLOROETHYLENE(1,2-DICHLOROETHENE)	2.4	96.94	C2H2CL2
123-91-1	E *	DIOXANE (1,4)	4.3	88.11	C4H8O2
1746-01-6	W	DIOXIN (2,3,7,8-TETRACHLORODIBENZODIOXIN	4.3	321.96	C12H4CL4O2
106-89-8	E *	EPICHLOROHYDRIN(1-CHLORO-2,3-EPOXYPROPAN	4.4	92.53	C3H5CLO
106-93-4	W	ETHYLENE DIBROMIDE(1,2-DIBROMOETHANE)	2.2	187.87	C2H4BR2
107-06-2	W*	ETHYLENE DICHLORIDE(1,2-DICHLOROETHANE)	2.1	98.96	C2H4CL2
75-21-8	E	ETHYLENE OXIDE (OXIRANE)	4.2	44.05	C2H4O
79-01-6	E *	ETHYLENE TRICHLORIDE(1,1,2-TRICHLOROETHE	2.4	131.40	C2HCL3
50-00-0	E *	FORMALDEHYDE (METHANAL)	5.1	30.03	CH2O
77-47-4	C *	HEXACHLOROCYCLOPENTADIENE	2.4	272.77	C5CL6
67-72-1	E *	HEXACHLOROETHANE	2.1	236.74	C2CL6
108-31-6	A	MALEIC ANHYDRIDE(2,5-FURANDIONE)	6.2	98.06	C4H2O3
74-87-3	A *	METHYL CHLORIDE (CHLOROMETHANE)	2.1	50.49	CH3CL
71-55-6	A *	METHYL CHLOROFORM(1,1,1-TRICHLOROETHANE)	2.1	133.41	CH3CCL3
75-09-2	A *	METHYLENE CHLORIDE (DICHLOROMETHANE)	2.1	84.94	CH2CL2
62-75-9	W*	N-NITROSODIMETHYLAMINE	7.6	74.08	C2H6N2O
98-95-3	A *	NITROBENZENE	7.2	123.11	C6H5NO2
59-89-2	W	NITROSOMORPHOLINE	7.6	116.11	C4H8N2O2
11097-69-1	E *	PCB-1254 PERCHLORINATED BIPHENYLS	2.2	325.80	C12H5CL5
127-18-4	E *	PERCHLOROETHYLENE(TETRACHLOROETHENE)	2.4	165.83	C2CL4
108-95-2	C *	PHENOL	3.2	94.11	C6H6O
75-44-5	W	PHOSGENE (CARBONYL CHLORIDE)	6.7	98.92	CCL2O
75-56-9	E	PROPYLENE OXIDE (METHYLOXIRANE)	4.4	58.08	C3H6O
108-88-3	A *	TOLUENE (METHYL BENZENE)	1.6	92.13	C7H8
95-53-4	C *	TOLUIDINE-ORTHO(2-AMINOTOLUENE)	7.1	107.16	C7H9N
79-00-5	W *	TRICHLOROETHANE(1,1,2-TRICHLOROETHANE)	2.1	133.42	C2H3CL3
75-01-4	W*	VINYL CHLORIDE (CHLOROETHENE)	2.4	62.50	C2H3CL
75-35-4	W*	VINYLIDENE CHLORIDE(1,1-DICHLOROETHENE)	2.4	96.94	C2H2CL2
1330-20-7	A *	XYLENES (DIMETHYLBENZENE)	1.6	106.20	C8H10

44 Compound(s) total

A = No data found
A* = In Megs Study: Not a Carcinogen.
C* = In Megs Study: Tumor Promotor or Cocarcinogen.
E* = In Megs Study: Suspected Carcinogen.
W* = In Megs Study: Known Carcinogen.

Based on data in: A Survey of Organic Air Po-lutants Tested for Carcinogenicity and Mutagencity, NCI Report No. 1-CP-95607, US Dept. of Health and Human Services, National Institute of Health, March 1982.

Table B-3. Data from Table B-2 arranged in order of functionality (from Table B-1). See Table B-2 for codes

```
    71-43-2   C  * BENZENE
   108-88-3  A   * TOLUENE (METHYL BENZENE)                          1.6    78.11 C6H6
  1330-20-7  A   * XYLENES (DIMETHYLBENZENE)                         1.6    92.13 C7H8
    74-87-3  A   * METHYL CHLORIDE (CHLOROMETHANE)                   1.6   106.20 C8H10
    75-09-2  A   * METHYLENE CHLORIDE (DICHLOROMETHANE)              2.1    50.49 CH3CL
    75-34-3  A     DICHLOROETHANE(1,1)                               2.1    84.94 CH2CL2
   107-06-2  A   * ETHYLENE DICHLORIDE(1,2-DICHLOROETHANE)           2.1    98.96 C2H4CL2
    67-66-3  A   * CHLOROFORM (TRICHLOROMETHANE)                     2.1    98.96 C2H4CL2
    71-55-6  A   * METHYL CHLOROFORM(1,1,1-TRICHLOROETHANE)          2.1   119.38 CHCL3
    79-00-5  A   * TRICHLOROETHANE(1,1,2-TRICHLOROETHANE)            2.1   133.41 CH3CCL3
    56-23-5  A   * CARBON TETRACHLORIDE(TETRACHLOROMETHANE)          2.1   133.42 C2H3CL3
    67-72-1  A   * HEXACHLOROETHANE                                  2.1   153.82 CCL4
   106-93-4  A     ETHYLENE DIBROMIDE(1,2-DIBROMOETHANE)             2.1   236.74 C2CL6
 11097-69-1  A   * PCB-1254 PERCHLORINATED BIPHENYLS                 2.2   187.87 C2H4BR2
    75-01-4   C  * VINYL CHLORIDE (CHLOROETHENE)                     2.2   325.00 C12H5CL5
   107-05-1  A     ALLYL CHLORIDE(3-CHLOROPROPENE)                   2.4    62.50 C2H3CL
   126-99-8  A     CHLOROPRENE (2-CHLOROBUTADIENE)                   2.4    76.53 C3H5CL
   540-59-0  A   * DICHLOROETHYLENE(1,2-DICHLOROETHENE)              2.4    88.54 C4H5CL
    75-35-4  A   * VINYLIDENE CHLORIDE(1,1-DICHLOROETHENE)           2.4    96.94 C2H2CL2
   108-90-7  A   * CHLOROBENZENE                                     2.4    96.94 C2H2CL2
   100-44-7  A   * BENZYL CHLORIDE (A-CHLOROTOLUENE)                 2.4   112.56 C6H5CL
    79-01-6  A   * ETHYLENE TRICHLORIDE(1,1,2-TRICHLOROETHE          2.4   126.59 C7H7CL
   106-46-7  A   * DICHLOROBENZENE(PARA) (1,4-DICHLOROBENZE          2.4   131.40 C2HCL3
   127-18-4  A   * PERCHLOROETHYLENE(TETRACHLOROETHENE)              2.4   147.01 C6H4CL2
    77-47-4   C  * HEXACHLOROCYCLOPENTADIENE                         2.4   165.83 C2CL4
   108-95-2  A   * PHENOL                                            2.4   272.77 C5CL6
   108-39-4   C  * CRESOL(META) (3-METHYLPHENOL)                     3.2    94.11 C6H6O
    75-21-8  A     ETHYLENE OXIDE (OXIRANE)                          3.2   108.40 C7H8O
   123-91-1  A   * DIOXANE (1,4)                                     4.2    44.05 C2H4O
  1746-01-6     W  DIOXIN (2,3,7,8-TETRACHLORODIBENZODIOXIN          4.3    88.11 C4H8O2
    75-56-9  A     PROPYLENE OXIDE (METHYLOXIRANE)                   4.3   321.96 C12H4CL4O2
   106-89-8  A   * EPICHLOROHYDRIN(1-CHLORO-2,3-EPOXYPROPAN          4.4    58.08 C3H6O
   542-88-1     W* CHLOROMETHYL ETHER(1,1'-DICHLOROMETHYL E          4.4    92.53 C3H5CLO
    50-00-0   C  * FORMALDEHYDE (METHANAL)                           4.5   114.96 C2H4CL2O
    75-07-0  A   * ACETALDEHYDE (ETHANAL)                            5.1    30.03 CH2O
   107-02-8   C  * ACROLEIN (PROPENAL)                               5.1    44.05 C2H4O
   108-31-6  A     MALEIC ANHYDRIDE(2,5-FURANDIONE)                  5.3    56.06 C3H4O
   107-13-1  A   * ACRYLONITRILE (2-PROPENENITRILE)                  6.2    98.06 C4H2O3
    75-44-5  A     PHOSGENE (CARBONYL CHLORIDE)                      6.4    53.04 C3H3N
    62-53-3    E * ANILINE (AMINOBENZENE)                            6.7    98.92 CCL2O
    95-53-4   C  * TOLUIDINE-ORTHO(2-AMINOTOLUENE)                   7.1    93.11 C6H7N
    98-95-3  A   * NITROBENZENE                                      7.1   107.16 C7H9N
    62-75-9    E * N-NITROSODIMETHYLAMINE                            7.2   123.11 C6H5NO2
    59-89-2  A     NITROSOMORPHOLINE                                 7.6    74.08 C2H6N2O
                                                                     7.6   116.11 C4H8N2O2

            44 Compound(s) total
            75-07-0 A   * ACETALDEHYDE (ETHANAL)
      FNC:   5.1    MW:   44.05    C2H40
MP: -121.00(     1   ) BP:   20.000 760 torr(     1    )
  (P)=767.000000[1.52            ](   20    )  S43502

            107-02-8  C  * ACROLEIN (PROPENAL)
      FNC:   5.3    MW:   56.06    C3H40
MP:  -87.00(     1   ) BP:   52.500 760 torr(     1    )
  (P)=214.000000[1.94            ](   20    )  603,624

            107-13-1 A   * ACRYLONITRILE (2-PROPENENITRILE)
      FNC:   6.4    MW:   53.04    C3H3N
MP:  -82.00(     1   ) BP:   78.500 760 torr(     1    )
  (P)= 80.000000[1.83            ](   20    )  603,624,S43704

            107-05-1 A     ALLYL CHLORIDE(3-CHLOROPROPENE)
      FNC:   2.4    MW:   76.53    C3H5CL
MP: -134.50(     1   ) BP:   44.000 760 torr(     1    )
  (P)=260.000000[2.64            ](   20    )

            62-53-3   E * ANILINE (AMINOBENZENE)
      FNC:   7.1    MW:   93.11    C6H7N
                   BP:  184.130 760 torr(     1    )
  (P)=  0.600000[                ](   20    )  624

            71-43-2  C  * BENZENE
      FNC:   1.6    MW:   78.11    C6H6
MP:    5.50(     1   ) BP:   80.100 760 torr(     1    )  K :  5.550
  (P)= 56.000000[2.77            ](   20    )  624,S45201

            100-44-7 A   * BENZYL CHLORIDE (A-CHLOROTOLUENE)
      FNC:   2.4    MW:  126.59    C7H7CL
MP:  -43.00(     1   ) BP:  179.300 760 torr(     1    )
log(P)=  0.900000[4.36           ](   20    )

            56-23-5 A   * CARBON TETRACHLORIDE(TETRACHLOROMETHANE
      FNC:   2.1    MW:  153.82    CCL4
MP:  -22.99(     1   ) BP:   76.540 760 torr(     1    )  K := 30.200
  (P)= 77.000000[5.3             ](   20    )  624,S43004

            108-90-7 A   * CHLOROBENZENE
      FNC:   2.4    MW:  112.56    C6H5CL
MP:  -45.60(     1   ) BP:  131.000 760 torr(     1    )  K :=  3.930
  (P)=  9.400000[3.80            ](   20    )  624,S45001

            67-66-3 A   * CHLOROFORM (TRICHLOROMETHANE)
      FNC:   2.1    MW:  119.38    CHCL3
MP:  -63.50(     1   ) BP:   61.700 760 torr(     1    )  K =  3.390
  (P)=140.000000[4.12            ](   20    )  624,S43003

            542-88-1    W* CHLOROMETHYL ETHER(1,1'-DICHLOROMETHYL
      FNC:   4.5    MW:  114.96    C2H4CL20
                   BP:  105.000 760 torr(     1    )
  (P)= 25.000000[4.0             ](   20    )
```

```
            126-99-8 A     CHLOROPRENE (2-CHLOROBUTADIENE)
      FNC:   2.4    MW:   88.54    C4H5CL
                   BP:   59.400 760 torr(     1    )
  (P)=170.000000[3.0             ](   20    )

            108-39-4  C  * CRESOL(META) (3-METHYLPHENOL)
      FNC:   3.2    MW:  108.40    C7H80
MP:   11.00(     1   ) BP:  202.000 760 torr(     1    )
  (P)=  0.100000[3.72            ](   20    )

            106-46-7 A   * DICHLOROBENZENE(PARA) (1,4-DICHLOROBENZ
      FNC:   2.4    MW:  147.01    C6H4CL2
MP:   53.00(     1   ) BP:  174.000 760 torr(     1    )  K =  2.720
  (P)=  1.500000[5.07            ](   20    )  625

            75-34-3 A     DICHLOROETHANE(1,1)
      FNC:   2.1    MW:   98.96    C2H4CL2
MP:  -97.00(     1   ) BP:   57.300 760 torr(     1    )  K =  5.450
  (P)=200.000000[3.44            ](   20    )  624

            540-59-0 A   * DICHLOROETHYLENE(1,2-DICHLOROETHENE)
      FNC:   2.4    MW:   96.94    C2H2CL2
MP:  -50.00(     1   ) BP:   47.500 760 torr(     1    )  K =  5.320
  (P)=200.000000[3.34            ](   20    )  624

            123-91-1 A   * DIOXANE (1,4)
      FNC:   4.3    MW:   88.11    C4H802
MP:   10.00(     1   ) BP:  101.100 760 torr(     1    )
  (P)= 20.000000[

            1746-01-6    W  DIOXIN (2,3,7,8-TETRACHLORODIBENZODIOXI
      FNC:   4.3    MW:  321.96    C12H4CL402
MP:  305.00(     1   )

            106-89-8 A   * EPICHLOROHYDRIN(1-CHLORO-2,3-EPOXYPROPA
      FNC:   4.4    MW:   92.53    C3H5CLO
MP:  -25.60(     1   ) BP:  117.000 760 torr(     1    )
  (P)= 12.000000[3.29            ](   20    )

            106-93-4 A     ETHYLENE DIBROMIDE(1,2-DIBROMOETHANE)
      FNC:   2.2    MW:  187.87    C2H4BR2
MP:   10.00(     1   ) BP:  131.500 760 torr(     1    )
  (P)= 12.000000[6.48            ](   20    )

            107-06-2 A   * ETHYLENE DICHLORIDE(1,2-DICHLOROETHANE)
      FNC:   2.1    MW:   98.96    C2H4CL2
MP:  -35.36(     1   ) BP:   83.470 760 torr(     1    )  K =  1.100
  (P)= 60.000000[3.35            ](   20    )  624,S43015

            75-21-8 A     ETHYLENE OXIDE (OXIRANE)
      FNC:   4.2    MW:   44.05    C2H40
MP: -111.00(     1   ) BP:   10.700 760 torr(     1    )  K :=  1.000
  (P)=999.000000[1.52            ](   20    )  S43601

            79-01-6 A   * ETHYLENE TRICHLORIDE(1,1,2-TRICHLOROETH
      FNC:   2.4    MW:  131.40    C2HCL3
MP:  -73.00(     1   ) BP:   86.700 760 torr(     1    )  K = 11.700
  (P)= 55.000000[4.53            ](   20    )  624
```

Table B-4. Physical properties of HAPs Sources: CRC Handbook (cont.)

Table B-4 (cont.)

```
               50-00-0  C  * FORMALDEHYDE (METHANAL)
        FNC:   5.1     MW:   30.03    CH2O
MP:  -92.00(     1    ) BP:  -21.000 760 torr(     1    )
   (P)=999.000000[1.067              ](   20    )  S43502

               77-47-4  C  * HEXACHLOROCYCLOPENTADIENE
        FNC:   2.4     MW:  272.77    C5CL6
MP:   -9.00(     1    ) BP:  239.000 753 torr(     1    )  K := 16.400
   (P)=  0.100000[9.42               ](   20    )  625

               67-72-1 A   * HEXACHLOROETHANE
        FNC:   2.1     MW:  236.74    C2CL6
MP:  186.00(     1    ) BP:  186.000 777 torr(     1    )  K =  9.850
   (P)=  0.400000[                   ](   20    )  625

               108-31-6 A    MALEIC ANHYDRIDE(2,5-FURANDIONE)
        FNC:   6.2     MW:   98.06    C4H2O3
MP:   52.00(     1    ) BP:  202.000 760 torr(     1    )
log(P)=  0.100000[3.4                ](   20    )

               74-87-3 A   * METHYL CHLORIDE (CHLOROMETHANE)
        FNC:   2.1     MW:   50.49    CH3CL
MP!  -97.73(     1    ) BP:  -24.200 760 torr(     1    )
log(P)=999.000000[1.70               ](   20    )  624,543001

               71-55-6 A   * METHYL CHLOROFORM(1,1,1-TRICHLOROETHANE
        FNC:   2.1     MW:  133.41    CH3CCL3
MP:  -30.41(     1    ) BP:   74.100 760 torr(     1    )  K :  4.920
   (P)=100.000000[4.6                ](   20    )  624,543014

               75-09-2 A   * METHYLENE CHLORIDE (DICHLOROMETHANE)
        FNC:   2.1     MW:   84.94    CH2CL2
MP:  -95.10(     1    ) BP:   40.000 760 torr(     1    )  K =  3.190
   (P)=300.000000[2.93               ](   20    )  624,543002

               62-75-9   E * N-NITROSODIMETHYLAMINE
        FNC:   7.6     MW:   74.08    C2H6N2O
                        BP:  154.000 760 torr(     1    )
   (P)= 20.000000[                   ](   20    )

               98-95-3 A   * NITROBENZENE
        FNC:   7.2     MW:  123.11    C6H5NO2
MP:    6.00(     1    ) BP:  210.800 760 torr(     1    )  K :=  0.024
   (P)=  0.400000[4.25               ](   20    )  625

               59-89-2 A     NITROSOMORPHOLINE
        FNC:   7.6     MW:  116.11    C4H8N2O2
MP:   29.00(     1    ) BP:  224.000 760 torr(     1    )
   (P)=  0.100000[

            11097-69-1 A   * PCB-1254 PERCHLORINATED BIPHENYLS
        FNC:   2.2     MW:  325.00    C12H5CL5
MP:   34.00(     1    ) BP:  260.000 760 torr(     1    )  K :=  1.000
   (P)=  0.100000[

               127-18-4 A   * PERCHLOROETHYLENE(TETRACHLOROETHENE)
        FNC:   2.4     MW:  165.83    C2CL4
MP:  -19.00(     1    ) BP:  121.000 760 torr(     1    )  K := 20.700
   (P)= 13.000000[5.03               ](   20    )  624,543017
```

```
               108-95-2 A   * PHENOL
        FNC:   3.2     MW:   94.11    C6H6O
MP:   43.00(     1    ) BP:  181.750 760 torr(     1    )  K =  0.001
   (P)=  0.200000[3.24               ](   20    )  625,545300

               75-44-5 A     PHOSGENE (CARBONYL CHLORIDE)
        FNC:   6.7     MW:   98.92    CCL2O
MP: -118.00(     1    ) BP:    8.200 760 torr(     1    )  K :=  1.000
   (P)=999.000000[3.4                ](   20    )

               75-56-9 A     PROPYLENE OXIDE (METHYLOXIRANE)
        FNC:   4.4     MW:   58.08    C3H6O
MP: -112.00(     1    ) BP:   34.230 760 torr(     1    )
   (P)=450.000000[2.0                ](   20    )  S43602

               108-88-3 A   * TOLUENE (METHYL BENZENE)
        FNC:   1.6     MW:   92.13    C7H8
MP:  -96.00(     1    ) BP:  110.600 760 torr(     1    )  K :  5.930
   (P)=450.000000[3.14               ](   20    )  624,545202

               95-53-4  C  * TOLUIDINE-ORTHO(2-AMINOTOLUENE)
        FNC:   7.1     MW:  107.16    C7H9N
MP:  -14.70(     1    ) BP:  200.230 760 torr(     1    )

               79-00-5 A   * TRICHLOROETHANE(1,1,2-TRICHLOROETHANE)
        FNC:   2.1     MW:  133.42    C2H3CL3
MP:  -36.70(     1    ) BP:  113.800 760 torr(     1    )
log(P)= 15.000000[4.6                ](   20    )  624,543020

               75-01-4  C  * VINYL CHLORIDE (CHLOROETHENE)
        FNC:   2.4     MW:   62.50    C2H3CL
MP: -153.80(     1    ) BP:  -13.370 760 torr(     1    )
   (P)=999.000000[2.15               ](   20    )  624,543060

               75-35-4 A   * VINYLIDENE CHLORIDE(1,1-DICHLOROETHENE)
        FNC:   2.4     MW:   96.94    C2H2CL2
MP: -122.10(     1    ) BP:   37.000 760 torr(     1    )  K := 15.000
   (P)=515.000000[                   ](   20    )  624

            1330-20-7 A   * XYLENES (DIMETHYLBENZENE)
        FNC:   1.6     MW:  106.20    C8H10
MP:  -47.40(     1    ) BP:  139.300 760 torr(     1    )
   (P)=  6.000000[3.66               ](   20    )  624,545222

          44 Compound(s) total
```

Appendix C. Emission - Ranked Probable Carcinogens for the United States.

Reference: "Potential Atmospheric Carcinogens", Montsanto Research Corp., Report to EPA, PB80-131428, Jan. 1980.

B-7

TABLE C-1. EMISSIONS-RANKED PROBABLE CARCINOGENS[a]

Rank	Chemical	Emissions, kg/yr
1	Trichloroethylene	1.7×10^8
2	Tetrachloroethylene	1.2×10^8
3	Vinyl chloride	1.2×10^8
4	Ethylene dichloride	9.8×10^7
5	Benzene	7.4×10^7
6	Chlordane[b]	9.6×10^6
7	Dioxane[b]	7.4×10^6
8	Ethylene dibromide	4.8×10^6
9	Chloroform	2.6×10^6
10	Carbon tetrachloride	1.6×10^7
11	Chlorobenzilate[b]	9.0×10^5
12	Dichlorobutene	8.7×10^5
13	Benzo(a)pyrene[b]	8.3×10^5
14	Toluene-2,4-diamine	4.4×10^5
15	Vinylidene chloride	4.1×10^5
16	Benzyl chloride[c]	4.1×10^5
17	Acrylonitrile	3.7×10^5
18	Epichlorohydrin	2.2×10^5
19	Benzidine	7.0×10^4
20	Methylene bis(chloroaniline)	4.5×10^4
21	Ethylenimine	2.7×10^4
22	DDT[d]	1.9×10^4
23	Chrysene	1.7×10^4
24	Heptachlor	1.1×10^4
25	Tetrachloroethane[b]	9.4×10^3
26	Dimethylhydrazine[c]	$<5.0 \times 10^3$
27	Dichlorobenzidine	4.5×10^3
28	Hydrazine	3.5×10^3
29	Dinitrotoluene	4.0×10^2
30	Diaminoanisole[c]	1.4×10^2
31	Trichlorfon	1.0×10^2
32	Benz(a)anthracene[c]	$<1.0 \times 10^2$
33	Bis(chloromethyl) ether	$<1.0 \times 10^2$
34	Captan	$<1.0 \times 10^2$
35	Nitrosodimethylamine	$<1.0 \times 10^2$
36	Ethyl carbamate (urethane)[c]	4.5
37	Aldrin (3.0×10^6)[b,e]	0
38	Polychlorinated biphenyls (1.8×10^5)[c,e]	0

---

[a] When more than one significant emission figure is available, the log average is used, with the MRC data base figure given twice the weight of the other values.

[b] Assumed emission factor of 1.00 of production.

[c] Assumed emission factor of 0.01 of production.

[d] Emitted from stationary sources (MRC Source Assessment Data Base, July 1977).

[e] Current production (emission) of zero, but average literature values also given.

TABLE C-2. EMISSIONS-RANKED POSSIBLE CARCINOGENS[a]

Rank	Chemical	Emissions, kg/yr
1	Formaldehyde	4.8×10^7
2	Dichloropropene[b]	2.8×10^7
3	Pentachlorophenol[b]	2.1×10^7
4	Cumene hydroperoxide	2.1×10^7
5	Methyl chloride	1.6×10^7
6	Ethylene oxide	9.7×10^6
7	Hexachlorobutadine	7.3×10^6
8	Chloroprene	6.9×10^6
9	Tetraethyl lead	6.6×10^6
10	Acrolein	6.5×10^6
11	Styrene	5.6×10^6
12	Morpholine	5.5×10^6
13	Propylene oxide	4.4×10^6
14	1,1-Dichloroethane	2.6×10^6
15	Di-(2-ethylhexyl) phthalate	2.4×10^6
16	Allyl chloride	7.1×10^5
17	Vinyl acetate	6.8×10^5
18	Hexachlorobenzene	2.3×10^5
19	1-Naphthylamine[c]	3.2×10^4
20	Mercaptobenzothiazole	2.7×10^4
21	Methylenedianiline	2.6×10^4
22	Di-tert-butyl peroxide[c]	1.4×10^4
23	Vinyl bromide	4.0×10^3
24	Dichloronaphthoquinone	9.0×10^2
25	Trichlorophenol	5.0×10^2
26	Nitrochlorobenzene	3.0×10^2
27	Dichlorovinyl dimethyl phosphate	2.0×10^2
28	Biphenyl (9.2×10^4)[d]	0

[a] When more than one significant emission figure is available, the log average is used, with the MRC data base figure given twice the weight of the other values.

[b] Assumed a release factor of 1.00 of production.

[c] Assumed a release factor of 0.01 of production.

[d] Current production of PCB's is zero, so assumed biphenyl emissions also zero. Literature value is also given.

TABLE C-3. EMISSIONS/PERSISTENT-RANKED PROBABLE CARCINOGEN

Rank	Chemical	Atmospheric half-life	Emissions, kg/yr, remaining after 24 hours
1	Ethylene dichloride	234 h	9.1×10^7
2	Tetrachloroethylene	2.0 d	8.5×10^7
3	Benzene	3.0 d	5.9×10^7
4	Vinyl chloride	12 h	3.0×10^7
5	Trichloroethylene	0.3 d	1.7×10^7
6	Carbon Tetrachloride	10 wk	1.6×10^6
7	Chlordane	N.A.[a]	9.6×10^6
8	Ethylene dibromide	20 h	2.1×10^6
9	Dioxane	9.6 h	1.3×10^6
10	Dichlorobutene	N.A.	8.7×10^5
11	Benzo(a)pyrene	N.A.	8.3×10^5
12	Chlorobenzilate	N.A.	9.0×10^5
13	Chloroform	13 h	7.2×10^5
14	Toluene-2,4-dimaine	N.A.	4.4×10^5
15	Benzyl chloride	N.A.	4.1×10^5
16	Acrylonitrile	N.A.	3.7×10^5
17	Vinylidene chloride	24 h	2.1×10^5
18	Benzidine	1 d	3.5×10^4
19	DDT	N.A.	1.9×10^4
20	Ethylenimine	1.5 d	1.7×10^4
21	Chrysene	-	1.7×10^4
22	Methylene bis(chloroaniline)	12 h	1.1×10^4
23	Heptachlor	N.A.	1.1×10^4
24	Tetrachloroethane	N.A.	9.4×10^3
25	Dichlorobenzidine	1 d	2.3×10^3
26	Epichlorohydrin	3 h	8.6×10^2
27	Dinitrotoluene	N.A.	4.0×10^2
28	Diaminoanisole	N.A.	1.4×10^2
29	Trichlorofon	N.A.	1.0×10^2
30	Captan	N.A.	$<1.0 \times 10^2$
31	Benz(a)anthracene	N.A.	$<1.0 \times 10^2$
32	Ethyl carbamate (urethane)	N.A.	4.5
33	Dimethylhydrazine	2.1 h	2.0
34	Hydrazine	1 h	>1.0
35	Nitrosodimethylamine	1 h	>1.0
36	Bis(chloromethyl) ether	25 min	>1.0
37	Aldrin (3.0×10^6)[b]	N.A.	0
38	Polychlorinated biphenyls (1.7×10^5)[c]	N.A.	0

[a] Persistence data could not be found. Assumed that the chemical does not degrade appreciably in 24 hours.

[b] Current production assumed to be zero, but literature value also cited.

[c] Primary source of biphenyl emissions was production of polychlorinated biphenyls, which has been stopped. Average literature value given in parentheses.

TABLE C-4. EMISSIONS/PERSISTENCE-RANKED POSSIBLE CARCINOGENS

Rank	Chemical	Atmospheric half-life	Emissions, kg/yr, remaining after 24 hours
1	Dichloropropene	3 d	2.2×10^7
2	Pentachlorophenol	N.A.[a]	2.1×10^7
3	Methyl chloride	1 yr	1.6×10^7
4	Styrene	N.A.	5.6×10^6
5	Morpholine	N.A.	5.5×10^6
6	Tetraethyl lead	2 d	4.7×10^6
7	Hexachlorobutadiene	<1 d	3.4×10^6
8	1,1-Dichloroethane	N.A.	2.6×10^6
9	Chloroprene	<10 h	1.3×10^6
10	Di-(2-ethylhexyl) phthalate	1 d	1.2×10^6
11	Vinyl acetate	N.A.	6.8×10^5
12	Hexachlorobenzene	2 d	1.6×10^5
13	Allyl chloride	9 h	1.1×10^5
14	Cumene hydroperoxide	3 h	8.2×10^4
15	Ethylene oxide	3 h	3.8×10^4
16	Methylenedianiline	N.A.	2.6×10^4
17	Propylene oxide	3 h	1.7×10^4
18	Acrolein	2.6 h	1.1×10^4
19	Di-tert-Butyl peroxide	79 h	1.1×10^4
20	1-Naphthylamine	12 h	8.0×10^3
21	Mercaptobenzothiazole	9.6 h	4.8×10^3
22	Vinyl bromide	N.A.	4.0×10^3
23	Dichloronaphthoquinone	N.A.	9.0×10^2
24	Trichlorophenol	N.A.	5.0×10^2
25	Nitrochlorobenzene	N.A.	3.0×10^2
26	Dichlorovinyl dimethyl phosphate	N.A.	2.0×10^2
27	Formaldehyde	1.2 h	45.8
28	Biphenyl (9.2×10^4)[b]	N.A.	0

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[a] N.A. - Persistence data could not be found. Assumed that the chemical does not degrade appreciably in 24 hours.

[b] Primary source of biphenyl emissions was production of polychlorinated biphenyls, which has been stopped. Average literature value given in parentheses.

Appendix D. Ranking of Suspected Carcinogens in California.

Reference: "An Inventory of Carcinogenic Substances Released into the Ambient Air of California," SAI Report #068-80-504 to CARB, Feb. 19, 1979.

Rating Factors For The Rating Systems

Both the additive and the multiplicative approaches were based upon the following rating factors:

R_1: Extent of present use in California
R_2: Projected growth in use in California
R_3: Potential for emissions during production and use
R_4: Stability in ambient air
R_5: Dispersion potential
R_6: Evidence of carcinogenicity

Table 3-3 shows how the candidate suspected carcinogens were rated against each rating factor. The range of scores was made the same for each factor so that, in the multiplicative approach, all the factors would have equal weight. In cases for which data were lacking, scientific judgment was used in assigning a score.

R_1: Extent of Present Use in California. Because the purpose of this exercise was to determine the relative importance of the suspected candidate carcinogens, R_1 was scaled to the most heavily used substance. Benzene, with an annual production and usage in California of nearly 10^9 lb, was the most heavily used material considered. Relative to this, materials with a usage under 10^5 lb/yr would be rated zero for R_1 and rejected as a candidate. However, before being rejected by this criterion, whether the substance might be emitted at a very high ra or under site-specific conditions which could result in high population exposures was considered.

Table D-1
DEFINITIONS OF THE RATING FACTORS USED

R_1: Present Use in California	
100% of max. (10^9 lb/yr)	5
10% of max. (10^8 lb/yr)	4
1% of max. (10^7 lb/yr)	3
0.1% of max. (10^6 lb/yr)	2
0.01% of max. (10^5 lb/yr)	1
< 0.01% of max. ($<10^5$ lb/yr)	0

R_2: Growth in California Use	
+20%	5
+10% to +20%	4
Positive growth to 10%	3
Stable or unknown	2
Decline	1
Being phased out	0

R_3 : Emission Potential	
Widespread use in consumer products	5
Relatively poor control over emissions	4
Relatively good control over emissions	2
Tightly controlled	1

R_4: Stability in Ambient Air	
Moderate to high stability ($t_{\frac{1}{2}} > 8$ hr)	5
Low to moderate stability ($t_{\frac{1}{2}} \sim 0\text{-}8$ hr)	3
Unstable ($t_{\frac{1}{2}} \sim$few minutes)	0

R_5: Dispersion Potential	
Emitted largely as vapor or fine particulate	5
Emitted largely as coarse particulate	1

R_6: Evidence of Carcinogenicity	
Known or suspected human carcinogen	5
Known mammalian carcinogen	4
Suspected mammalian carcinogen or known mammalian mutagen	3
Ames test positive	2
Precursor or co-carcinogen	1

R_2: Growth in California Use. This factor attempted to take into account that the chemical industry is in continual change. Pollutants of concern today may be phased out, while use of others may rise dramatically, increasing their importance as pollutants. In evaluating the rate of change of consumption of a substance in California, two types of information sources were generally employed. First, publications such as general reference works on industrial chemistry and chemical-specific studies, which are generally more up-to-date than the former, were examined for growth forecasts. In most cases, these forecasts are on a nationwide basis. Occasionally clues are provided which enable one to evaluate potential growth in California relative to the national forecasts. Second, in our many telephone conversations with producer and user representatives, we gathered their views on national and, especially, California growth. Our emphasis was therefore on contacting representatives who are intimately involved in the California market for each substance. In this way, a reasonable estimate of the growth in the use of each substance in California was ascertained. Nevertheless, such estimates are often relatively imprecise. For this reason, broad ranges in growth rate were used in assigning values to R_2. Also when we were aware of developments which could most likely result in a change in the growth rate, this information was factored into the choice of a value for R_2. As an example, asbestos consumption is stable or is declining at quite a slow rate. However, the pending phase-out of asbestos in motor vehicle friction materials will hasten the decline in asbestos consumption, further encouraging the assignment of a value of 1 for R_2.

R_3: Emission Potential. As an initial attempt to account for the likelihood and significance of release into the atmosphere determination of the emissions of substances of most concern to the CARB is part of Task II i.e. the Emissions Inventory. As part of that task emissions potential will be quantified by utilizing process information, site inspecting ,component leakage rates, etc. Because expending a great deal of effort on possible candidate carcinogens which would be eliminated from further consideration would not have been feasible, a surrogate measure of emission potential, based upon knowledge of the substance's manufacture and use, was employed. The highest rating went to substances which, like benzene, are widely used, especially in consumer products. A slightly lower rating went to substances which are routinely emitted from industrial processes during production and use. Volatility and particle size can greatly affect emissions. Some materials are employed in such a way that emissions are quite low even though tight emission control may not be required by law. This situation exists when processes and chemical reactivities are such that little of a chemical escapes to the atmosphere. Materials in this category were assigned a value of 2 for R_3. Substances which, under federal or state regulations, may not be discharged to the exterior environment but which could be discharged by accident received by the lowest rating.

R_4: Stability in Ambient Air. The stability of a compound in the atmosphere was evaluated on the basis of its propensity to decompose in ambient air. Materials with half-lives of greater than eight hours were considered moderately to highly stable and rated 5. Low to moderate stability was assigned to substances with half-lives between zero and eight hours. Compounds known to exist in air for only a few minutes would be rated zero and rejected as candidates. Even though their oxidation state or anion associations may change in the atmosphere, metals do not degrade and were considered stable; asbestos is likewise stable. Many of the decomposition reactions of organic molecules are mediated by light. Such substances, if released at night, would have several hours to disperse throughout local communities. Even in the daytime, a compound with a half-life of four hours could travel for four hours in local winds and still be present in half the quantity originally emitted. Thus a half-lfie of four hours allows considerable time for dispersion to local communities, even though in other contexts it may be considered brief.

R_5: Dispersion Potential. A rapid way of assessing the relative potential of different substances to spread from the point of release is to note their physical state under normal ambient conditions. Accordingly, we have ranked materials equipped as vapors or fine particulates the highest and coarse particulates the lowest. Intermediate values are possible for varying amounts of fine and coarse particulate emissions from the same source or from different sources.

R_6: Evidence of Carcinogenicity. Research is on-going to establish relative potencies of carcinogens. Much of this research involves in vitro techniques such as the Ames bacterial mutagenicity test. Extrapolating data from these kinds of tests to whole animals and humans is problematic. In a few cases, some measure of the relative potencies of substances in causing cancer in humans exists. However, for most of the substances considered in this study, insufficient potency data of any kind exists. Therefore a less quantitative measure of the carcinogenic potential of each candidate substance was used. The highest-rated ones would be those for which there is strong evidence of carcinogenesis in humans. Examples are asbestos, which is implicated in mesothelioma; vinyl chloride, which has been identified as the agent for liver cancer in exposed workers; and bis(chloromethyl)ether, shown by epidemiological studies to cause lung cancer in resin workers. The next-highest rated substances are those for which human carcinogenicity is unknown but which have produced cancer on one or more mammalian species in laboratory tests. Next are those which have not been shown to be carcinogens, but which have proven to be mutagenic in test animals. Substances for which the only knowledge of carcinogenic potential is a positive Ames test (producing mutations in histidine-requiring strains of Salmonella) are rated 2. Finally, substances which are implicated only as precursors or co-carcinogens are rated lowest.

Arguments can be raised regarding the validity of the evidence of carcinogenicity, and the evidence often changes rapidly as chemicals are newly tested and retested and data evaluated and reevaluated. However, to enter into these debates was not within the scope of this study. Conclusions about carcinogenicity drawn by the IARC or the National Cancer Institute were accepted in this study, regardless of dosage or route of administration.

Weighting Factors

In the additive ranking scheme, each rating criterion is weighted according to its importance relative to the other criteria. Little precedent exists for assigning these weights. In SAI's judgement, as generally agreed by the Panel, R_1, R_3 and R_6 are more important than the other criteria; of these, the evidence of carcinogenicity was considered to be the most important. W_1 and W_3 were set at 0.2 ; W_6 was assigned a value of 0.3, and W_2, W_4, and W_5 were set at 0.1. In consideration of the potential sensitivity of the ranking to the weighting factor assignments, the candidates were also ranked using equally weighted criteria (Section 3.3.3).

Table D-2

RATING FACTOR ASSIGNMENTS

	R_1	R_2	R_3	R_4	R_5	R_6
Arsenic	3	3	4	5	3	5
Asbestos	5	1	5	5	5	5
Benzene	5	3	5	5	5	5
Cadmium	2	3	4	5	5	5
Carbon Tetrachloride	3-4	3	3	5	5	4
Chloroform	3	3	4	5	5	4
Chromium	3	3	4	5	3	5
1,4-Dioxane	2	3	4	3	5	4
Epichlorohydrin	2	3	2	4	5	4
Ethylene Dibromide	3-4	1	5	5	5	4
Ethylene Dichloride	4-5	3	5	5	5	4
Inorganic Lead	4	1	5	5	4	4
Alkyl Lead	3-4	1	5	5	5	3
Maleic Anhydride	3	4	2	2	1	3
Nickel	2	3	4	5	4	5
Nitrosamines	3	3	4-5	3	5	5
Perchloroethylene	4	3	4	5	5	4
Phenol	2-3	3	4	3	5	3
PAH	1-3	4	5	5	5	5
Propylene Oxide	3	3	3	3	5	3
Trichloroethylene	0-2	0-1	5	5	5	4
Vinyl Chloride	5	3	1-4	4	5	5

Table D-3

FINAL SELECTION OF CANDIDATES[a]

Highest Consensus Ranking

- Arsenic
- Asbestos
- Benzene
- Cadmium
- Carbon Tetrachloride
- Chloroform
- Ethylene Dibromide
- Ethylene Dichloride
- Nitrosamines
- Perchloroethylene
- Polycyclic Aromatic Hydrocarbons (PAH)

Highly Ranked But No Inventory Recommended At This Time

- Vinyl Chloride
- Gasoline and Engine Exhausts
- Tobacco Smoke
- Pesticides

Appendix E. Industrial Sources of Potentially Toxic Substances

Reference: George E. Weant et al, Engineering Science Report to USEPA-OAQPS, Durham, NC, December 1983

Table E-1. Industrial Sources of Acrylonitrile Emissions

Production of:

- Acrylamide
- Acrylic & modacrylic resins and fibers
- Acrylonitrile
- Acrylonitrile-butadiene-styrene resins (ABS/SAN resins)
- Adiponitrile
- Monosodium glutamate
- Nitrile elastomer
- Nylon
- - Picoline
- Polyacrylonitrile
- Sarans

Table E-2. Industrial Sources of Allyl Chloride Emissions

Production of:

- Acrylonitrile
- Allyl chloride
- Epichlorohydrin
- Glycerol

Table E-3. Industrial Sources of Benzene Emissions

- Production of:
  - Acrylonitrile
  - Adiponitrile
  - Alkylbenzyenes and dialkylbenzenes
  - Aniline
  - Benzene
  - Benzene-m-disulfonic acid
  - Benzonitrile
  - Benzosulforic acid
  - α- Benzoylbenzoic acid
  - Chlorobenzene
  - Cumene
  - Cumene sulfonate - ammonium salt
  - Cumene sulfonic acid
  - Cyclohexane
  - Detergent alkylates
  - Dichlorobenzenes
  - m- & p- Diisopropylbenzene
  - Diphenyl
  - Ethylbenzene
  - Fumaric acid
  - Linear alkylbenzene
  - Maleic anhydride
  - Nitrobenzene
  - Nylon 6
  - Phenol
  - Phenol/acetone
  - Styrene
  - 1,2,4-Trichlorobenzene
- Asphalt plants
- Coke ovens - pushing, doors, quenching, byproduct plant
- Gasoline distribution and handling
- Gasoline refining
- Iron foundries (mold and core decomposition)
- Solvent evaporation - degreasers
- Solvent users - paints, adhesives, thinners, textiles

Table E-4. Industrial Sources of Benzyl Chloride Emissions

Production of:
- Benzyl alcohol
- Benzyl chloride
- Butyl benzyl phthalate
- Quarternary ammonia compounds

Table E-5. Industrial Sources of Beryllium Emissions

Production of:
- Beryllium metal
- Be-Cu alloys
- Beryllium fabrication
- Beryllium oxide
- Carbon black
- Cement

Ceramics manufacturing
Coke ovens
Combustion - coal, diesel, oil
Feldspar mining and processing
Iron foundries
Mica mining and processing
Municipal incineration
Sewage sludge incineration
Waste incineration

Table E-6. Industrial Sources of Cadmium Emissions

Automobile tire use
Cadmium-barium stabilizer production and use
Cadmium-nickel battery production
Cadmium pigment production
Carbon black production
Cement production
Coke ovens
Combustion - coal, oil
Copper mining
Copper smelting - primary and secondary
Electroplating
Iron and steel production
Iron foundries
Lead mining
Lead smelting - primary
Moth proofing agents for textiles
Municipal incineration
Nickel - primary
Nonferrous alloy production
Sewage sludge incineration
Steel - primary and secondary
Waste incineration
Zinc mining
Zinc smelting - primary and secondary

Table E-7. Industrial Sources of Carbon Tetrachloride Emissions

- Production of:
    - Atrazine
    - Carbon tetrachloride
    - Chloroform
    - Chlorophenol
    - Chlorotirfluoromethane
    - Dichlorodifluoromethane
    - Floor waxes
    - Fluorocarbon gases
    - Methyl chloride
    - Methylene chloride
    - Paints and lacquers
    - Pesticides
    - Printing inks
    - Polishes for shoes and furniture
    - Rubber cement
    - Stains
    - Trichloroethylene
- Solvents - degreasing
- Solvent use in oil, wax, and fat extracts
- Textiles - scouring and dry cleaning

Table E-8. Industrial Sources of Chlorobenzene Emissions

Production of:
    Chlorobenzene
    Chlorosulfonic acid
    Dichlorobenzenes
    Dicofol
    Diphenyl oxide
    Nitrochlorobenzene
Solvents - degreasing
    - pesticide
Textiles - dye accelerants
    - dye carriers

Table E-9. Industrial Sources of Chloroform Emissions

Production of:
    Carbon tetrachloride
    Chloroform
    Fluorocarbons (chlorodifluoromethane)
    Fluorocarbon resins
    Methyl chloride
    Methylene chloride
    Solvents for pharmaceuticals
    Solvents for pesticides
    Trifluralin

Table E-10. Industrial Sources of Chloroprene

Production of:
    Adiponitrile
    Chloroprene
    Polychloroprene (neoprene)
    Polyvinyl chloride

Table E-11. Industrial Sources of Cresol (o-, m-, p-cresol). Emissions

- Production of:
  - Antioxidants
  - Cresols
  - Cresylic acid
  - Cresylic diphenol phosphate (CDP)
  - Disinfectants/cleaning compounds
  - 2,6 - ditert butyl-p-cresol (BHT)
  - Pesticides
  - Phenolic resins
  - Pyrethroid pesticides
  - Tricresyl phosphate (TCP)
- Coke ovens
- Coke quench tower
- Ore flotation
- Solvent-wire enamel

Table E-12. Industrial Sources of p-Dichlorobenzene Emissions

- Production of:
  - Chlorobenzene
  - o- Dichlorobenzene
  - p- Dichlorobenzene
  - Pesticide intermediates
  - Space deodorants
- Degreasing
- Moth control
- Textiles - thermasol dye ranges

Table E-13. Industrial Sources of Dimethylamine (Dimethyl Nitrosamine) Emissions

- Production of:
  - Dimethyl acetamide
  - Dimethylamines
  - Dimethyl formamide
  - Dimethyl hydrazine
  - Lauryl dimethylamine oxide
  - Pesticides
  - Rubber industry chemical accelerators
- Fish meal processing
- Combustion - Rocket fuel, boiler, and motor fuels

Table E-14. Industrial Sources of Dioxin Emissions

Combustion - diesel, gasoline, wood, oil, coal
Incinerators
Pentachlorophenol production
Trichlorophenol production
2,4,5-trichlorophenoxy acetic acid (2,4,5-T) production
2,4,5-T application (weed control)
Wood preservation using pentachlorophenol

Table E-15. Industrial Sources of Epichlorohydrin Emissions

- Production of:
  - Epichlorohydrin
  - Epichlorohydrin elastomers
  - Epoxy resins
  - Glycerin (synthetic)
  - Glycerol
  - Glycidol ethers
  - Ion-exchange resins
  - Surfactants
  - Water treatment resins
  - Wet-strength resins for paper

Table E-16. Industrial Sources of Ethylene Dichloride Emissions

- Production of:
  - Ceramic paste used in electronic circuit systems
  - Chlorobenzene
  - Ethylchloride
  - Ethyleneamines
  - Ethylene diamine
  - Ethylene dichloride
  - Methyl chloride
  - Methyl chloroform
  - Methylene chloride
  - Perchloroethylene
  - Polysulfide compounds (rubber)
  - Polyvinyl chloride
  - Trichloroethylene
  - Vinyl chloride monomer
  - Vinylidene chloride
- Grain fumigants
- Lead scavenger in gasoline

Table E-17. Industrial Sources of Ethylene Oxide Emissions

Production of:
- 2 - butoxyethanol
- Diethylene glycol
- Ethanolamines
- Ethoxyethanol
- Ethoxylated mixed linear alcohols
- Ethoxylated nonylphenol
- Ethoxylated octylphenol
- Ethylene glycol antifreeze
- Ethylene glycol polyester
- Ethylene Oxide
- Glycol ethers
- Surface active agents
- Triethylene glycol

Table E-18. Industrial Sources of Hexachlorocyclopentadiene Emissions

Production of:
- Flame retardant resins (chlorendic diesters)
- Flame retardants - Het-acid
  - Het-anhydrite
  - Dichlorane plus
- Hexachlorocyclopentadiene
- Pesticides - Chloradane
  - Endosulfane
  - Heptachlor

Table E-19. Industrial Sources of Maleic Anhydride Emissions

Production of:
- Alkyd resins
- Captan
- Chlorendic andydride
- Fumaric acid & agricultural pesticides
- Maleic acid
- Maleic anhydride
- Maleic hydrazide
- Phthalic anhydride
- Polyester resins - unsaturated

Table E-20. Industrial Sources of Mercury Emissions

Battery manufacture
Carbon black production
Cement production
Chlor-alkali
Coke ovens
Combustion - coal, fuel oil, gas
Copper mining & smelting
Fungicide production and use
Herbicide production and use
Instrument manufacture
Iron foundries
Lamp manufacture
Lead mining & smelting
Lime processing
Mercury compounds - halides, nitrates, oxides, etc.
Mining and processing of mercury
Municipal incineration
Paint production and formulation
Pesticides manufacture-nonagricultural
Petroleum refineries
Pharmaceutical manufacture
Phenyl mercurial production - mothproofing for textiles
Potassium hydroxide
Sewage sludge incineration
Urethane production
Vat dyes
Waste incineration
Zinc mining & smelting

Table E-21. Industrial Sources of Methyl Chloride Emissions

Production of:
    Acetaldehyde
    Cacodylic acid
    Carbon tetrachloride
    Chloroform
    DSMA
    Ethylene dichloride
    Methyl chloride
    Methylene chloride
    Methyl parathion
    MSMA
    Tetraethyl/tetramethyl lead
    Vinyl acetate

Table E-22. Industrial Sources of Methyl Chloroform Emissions

- Production of:
  - Adhesives
  - Drain cleaner
  - Fabric cleaners
  - Lubricant & coolant for cutting oils
  - Methyl chloroform
  - Methylene chloride
  - Sealants (paints, etc.)
  - Vinylidene chloride
- Metal degreasing & cleaning
- Solvent - urethane coating and others
- Textiles - used as crease resistant finish

Table E-23. Industrial Sources of Methylene Chloride Emissions

- Production of:
  - Carbon tetrachloride from methane
  - Chloroform
  - Methyl chloride
  - Methylene chloride
- Metal degreasing
- Paint and varnish remover
- Plastics processing

Table E-24. Industrial Sources of Nickel Emissions

- Production of:
  - Alloy steel
  - Carbon black
  - Cement
  - Coke
  - Cyclohexanone/cyclohexanol & cyclohexylamine
  - Ferroalloys
  - Iron & steel
  - Mining of nickel
  - Nickel compounds - other (except sulfate)
  - Nickel sulfate
  - Nonferroalloys
  - Stainless steel
- Combustion - coal, diesel fuel, and oil
- Electroplating
- Iron foundries
- Municipal incineration
- Sewage sludge incineration
- Waste incineration

Table E-25. Industrial Sources of Phenol Emissions

- Production of:
  - Acetone from cumene
  - Adipic acid
  - Aniline
  - Biphenol A
  - Caprolactum
  - Carbon black
  - Chlorophenol
  - Cresols
  - Cresyldiphenyl phosphate
  - Cyclohexanone/cyclohexanol & cyclohexylamine
  - Dodecylphenol
  - p- nitrophenol
  - Nonylphenol
  - Octylphenol
  - Pentachlorophenol (PCP) & sodium salts
  - Phenol
  - Phenolic resins
  - Phenol mercuricals - moth proofing agents
  - Polycarbonate resins
  - Polyvinyl chloride
  - Salicylates, excluding aspirin
  - Salicylic acid
  - Silvex
  - Trichlorophenols
- Coke oven door leaks
- Iron foundries - mold & core decomposition
- Textiles - dye accelerants
  - - dye carrier
  - - resin finishing - tenter frames
  - - resin finishing curing ovens

Table E-26. Industrial Sources of Phosgene Emissions

- Production of:
  - Bromacil
  - Chloroform (possible secondary pollutant due to oxidation of chloroform in sunlight)
  - Isocyanates
  - Methylene chloride (possibly due to exposure of methylene chloride to hot surfaces or open flames)
  - Phosgene
  - Polycarbonates & polycarbonate resins
  - Polymeric isocyanates
  - Polymethylene polyphenyl isocyanate
  - Toluene diisocyanate

Table E-27. Industrial Sources of Nitrobenzene Emissions

Production of:
  Aniline
  Nitroaniline
  Nitrobenzene
Chemical intermediates used for dichloranilines and dinitrobenzenes
Solvent - cellulose ether
  - petroleum industry

Table E-28. Industrial Sources of Nitrosomorpholine Emissions

Corrosion inhibitor use
Morpholine production
Optical brightener manufacture
Polishes and waxes production
Rubber chemicals production

Table E-29. Industrial Sources of Perchloroethylene Emissions

Degreasing - solvent evaporation
Dichlorotetrafluoroethane production
Ethylene dichloride production
Methylene chloride production
Perchloroethylene production
Textiles - dry cleaning
  - dye carrier in polyester
  - pressure dying knits
  - heat setting
  - curing
  - scouring

Table E-30. Industrial Sources of Polychlorinated Biphenyl (PCB) Emissions

Waste Incineration

At present, all other emissions are non-industrial resulting from incineration of PCB's, disposal of electrical equipment, and landfill sites.

Table E-31. Industrial Sources of Propylene Oxide Emissions

Production of:
- Dipropylene & tripropylene glycol
- Glycol ethers
- Polyester polyols
- Propyl glycol
- Propylene Oxide
- Surfactant glycol
- Urethane polyols

Table E-32. Industrial Sources of Radionuclides

Uranium from coal & coal combustion

Table E-33. Industrial Sources of Toluene Emissions

- Production of:
  - Acrylonitrile
  - Benzaldehyde
  - Benzene
  - Benzyl chloride
  - Benzoic acid
  - Chloroprene/neoprene
  - p-Cresol
  - Dimethoate
  - Ethylene-propylene rubber
  - Ethylene-propylene terpolymer
  - Malathion
  - Phenol
  - Polychloroprene
  - Ronnel
  - Styrene
  - Toluene
  - Toluene diisocyanate
  - Toluene sulfonic acid
  - Vinyl toluene
  - Xylenes
- Coke ovens
- Gasoline distribution
- Iron foundries - mold & core decomposition
- Solvent evaporation - paints and coatings
  - adhesive
  - ink
  - pharmaceutical
  - degreasing
  - textiles

Table E-34. Industrial Sources of Trichloroethylene Emissions

- Methyl chloroform production
- Perchloroethylene production from trichloroethylene
- Solvent evaporation - metal degreasing
  - adhesives
  - sealants
  - lubricants
- Textiles - scouring
  - dry cleaning
  - tenter frame
- Trichloroethylene production

Table E-35. Industrial Sources of Vinyl Chloride Emissions

- Production of:
    - Ethylene dichloride
    - Methyl chloroform
    - Polyvinyl chloride
    - Polyvinylvinylidene chloride
    - Vinyl chloride
- Carpet backing adhesive

Table E-36. Industrial Sources of Vinylidene Chloride Emissions

- Production of:
    - Ethylene dichloride
    - Polyvinyl chloride
    - Polyvinylvinylidene chloride
    - Vinylidene chloride
- Coatings in textile manufacturing

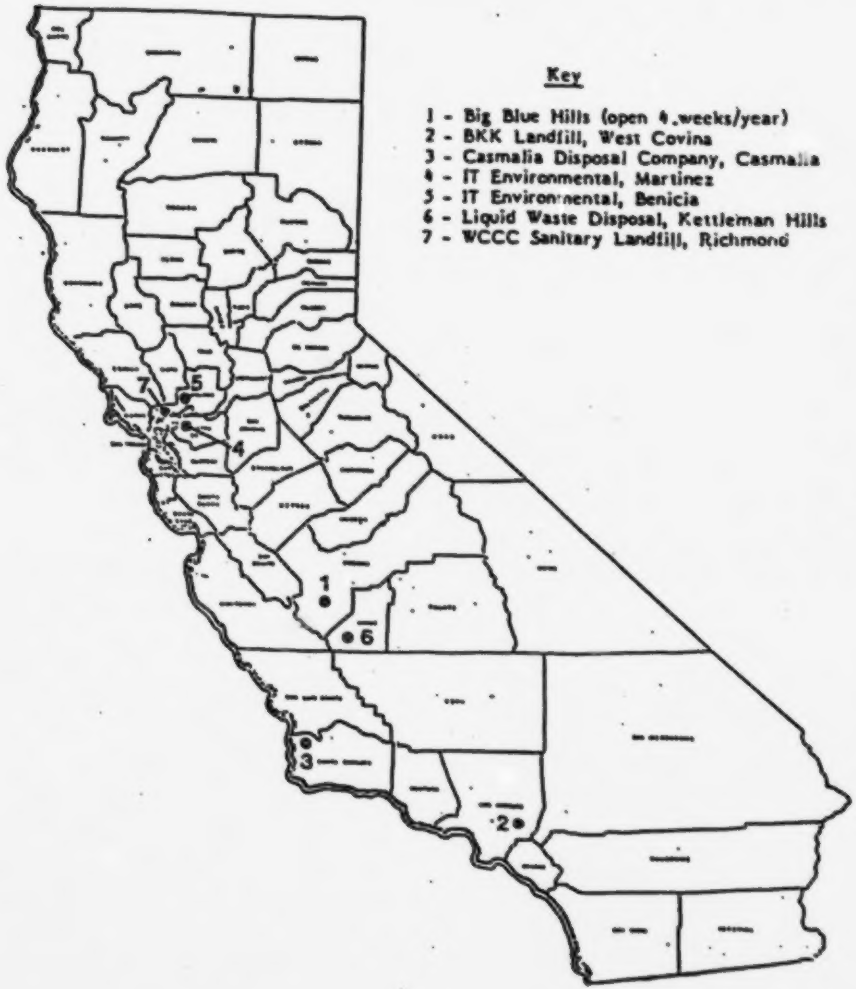
Table E-37. Industrial Sources of Xylene Emissions

- Production of:
    - Dimethylterephthalate
    - Ethylbenzene
    - Isophthalic acid
    - Maleic anhydride
    - Methyl parathion
    - Pesticides, agricultural
    - Phthalic anhydride
    - Terephthalic acid
    - Xylene
    - Xylene sulfonate - sodium salt
    - Xylene sulfonate - ammonium salt
    - Xylene sulfonate - potassium salt
    - Xylidenes
- Gasoline backblending
- Gasoline distribution
- Iron foundries - mold and core decomposition
- Solvent - adhesives
    - textiles
    - degreasing

APPENDIX F

Site Sketches for Several California Landfills

Figure F-1. **LOCATION OF CALIFORNIA'S CLASS I HAZARDOUS WASTE DISPOSAL FACILITIES**


Key
1 - Big Blue Hills (open 4 weeks/year)
2 - BKK Landfill, West Covina
3 - Casmalia Disposal Company, Casmalia
4 - IT Environmental, Martinez
5 - IT Environmental, Benicia
6 - Liquid Waste Disposal, Kettleman Hills
7 - WCCC Sanitary Landfill, Richmond
7
5
4
1
6
3
2

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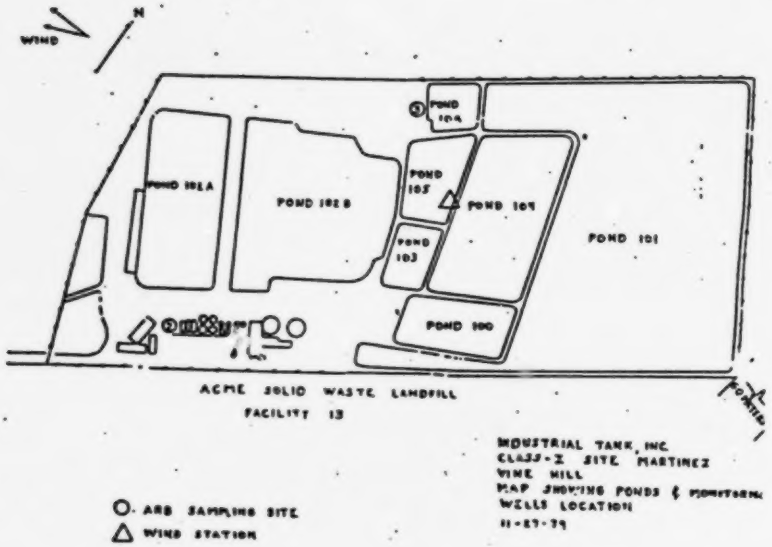
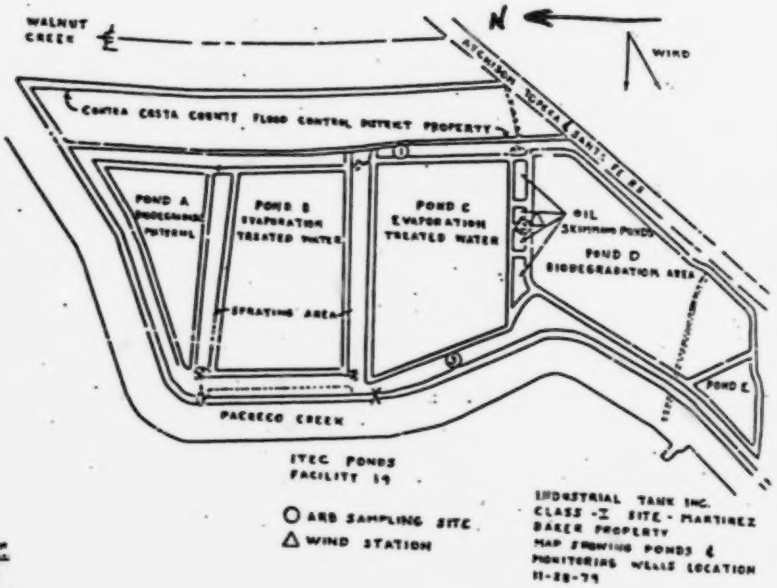

WIND
N
POND 104
POND 102 A
POND 102 B
POND 105
POND 109
POND 101
POND 103
POND 100
ACME SOLID WASTE LANDFILL
FACILITY 13
INDUSTRIAL TANK, INC
CLASS-I SITE MARTINEZ
VINE HILL
MAP SHOWING PONDS & MONITORING
WELLS LOCATION
11-27-79
○ ARB SAMPLING SITE
△ WIND STATION


WALNUT CREEK
N
WIND
ATCHISON TOPEKA & SANTA FE RR
CONTRA COSTA COUNTY FLOOD CONTROL DISTRICT PROPERTY
POND A
PROCESSING
POTENTIAL
POND B
EVAPORATION
TREATED WATER
POND C
EVAPORATION
TREATED WATER
OIL
SKIMMING PONDS
POND D
BIODEGRADATION AREA
SPRAYING AREA
POND E
PACHECO CREEK
ITEC PONDS
FACILITY 19
○ ARB SAMPLING SITE
△ WIND STATION
INDUSTRIAL TANK INC.
CLASS -I SITE - MARTINEZ
BAKER PROPERTY
MAP SHOWING PONDS &
MONITORING WELLS LOCATION
11-28-79

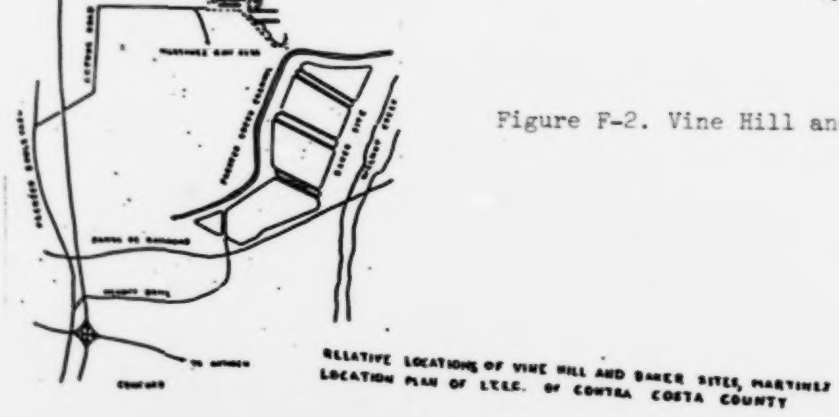

BAKER SITE
WALNUT CREEK
TO ANTIOCH
CONCORD
RELATIVE LOCATIONS OF VINE HILL AND BAKER SITES, MARTINEZ
LOCATION PLAN OF I.T.C.C. OF CONTRA COSTA COUNTY

Figure F-2. Vine Hill and Baker Landfills, Martinez.

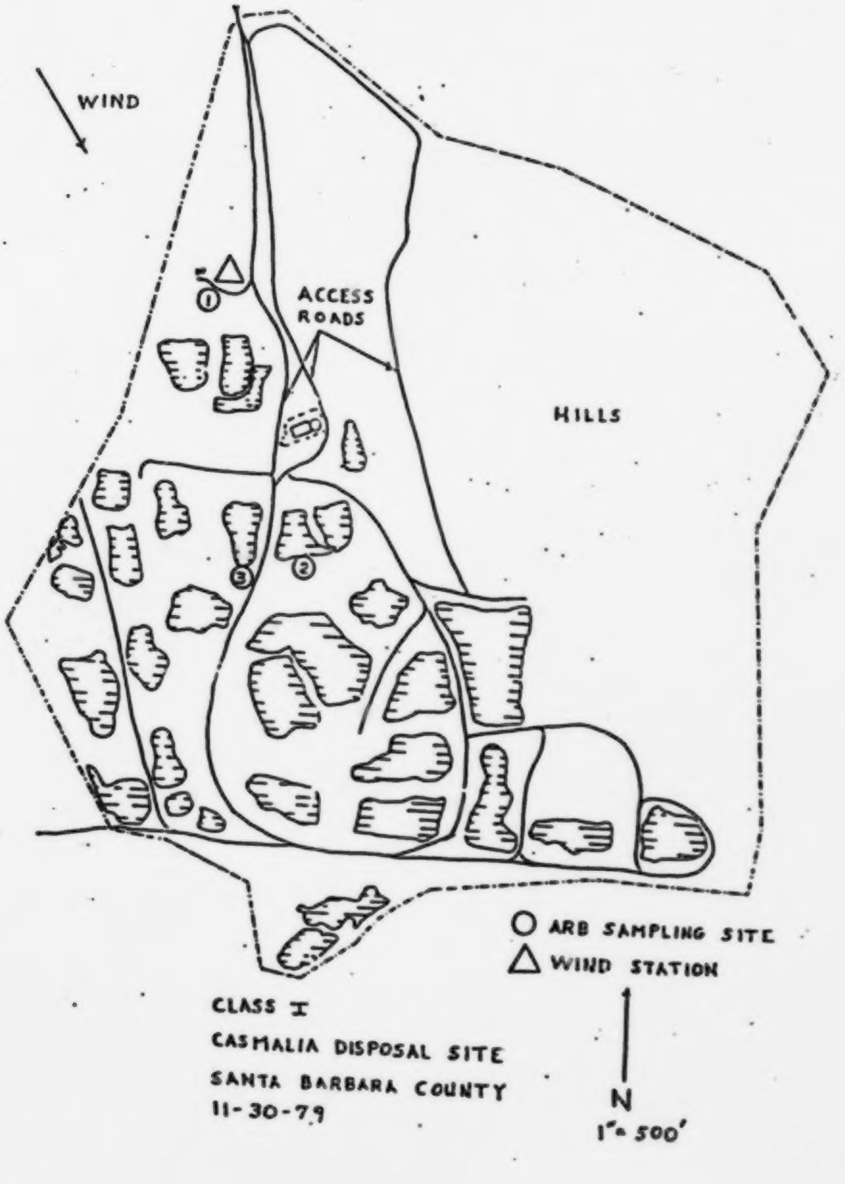

WIND
ACCESS ROADS
HILLS
①
②
③
○ ARB SAMPLING SITE
△ WIND STATION
CLASS I
CASMALIA DISPOSAL SITE
SANTA BARBARA COUNTY
11-30-79
N
1" = 500'

Figure F-3. Casmalia Landfill.

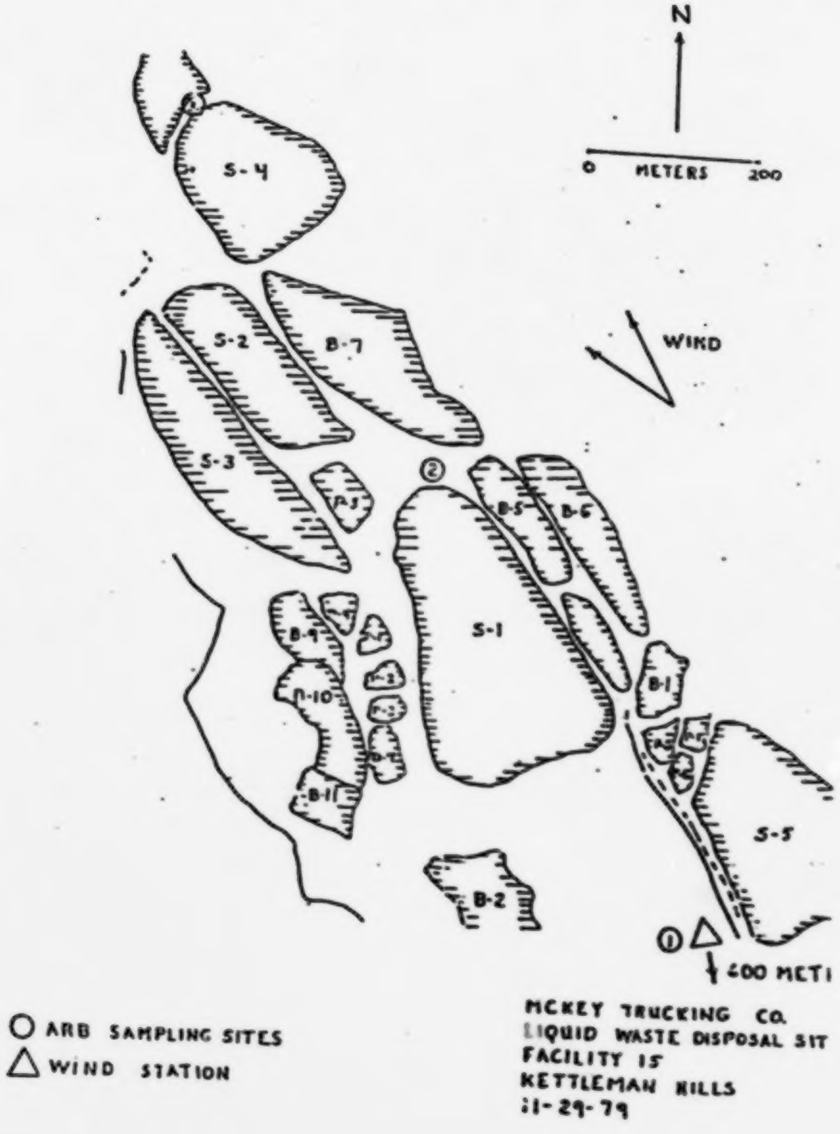

N
0 METERS 200
WIND
S-4
S-2
B-7
S-3
②
B-5
B-6
S-1
B-9
B-10
B-11
B-1
B-2
S-5
①
400 METI
O ARB SAMPLING SITES
△ WIND STATION
MCKEY TRUCKING CO.
LIQUID WASTE DISPOSAL SIT
FACILITY 15
KETTLEMAN HILLS
11-29-79

Figure F-4. Kettleman Hills Landfill.

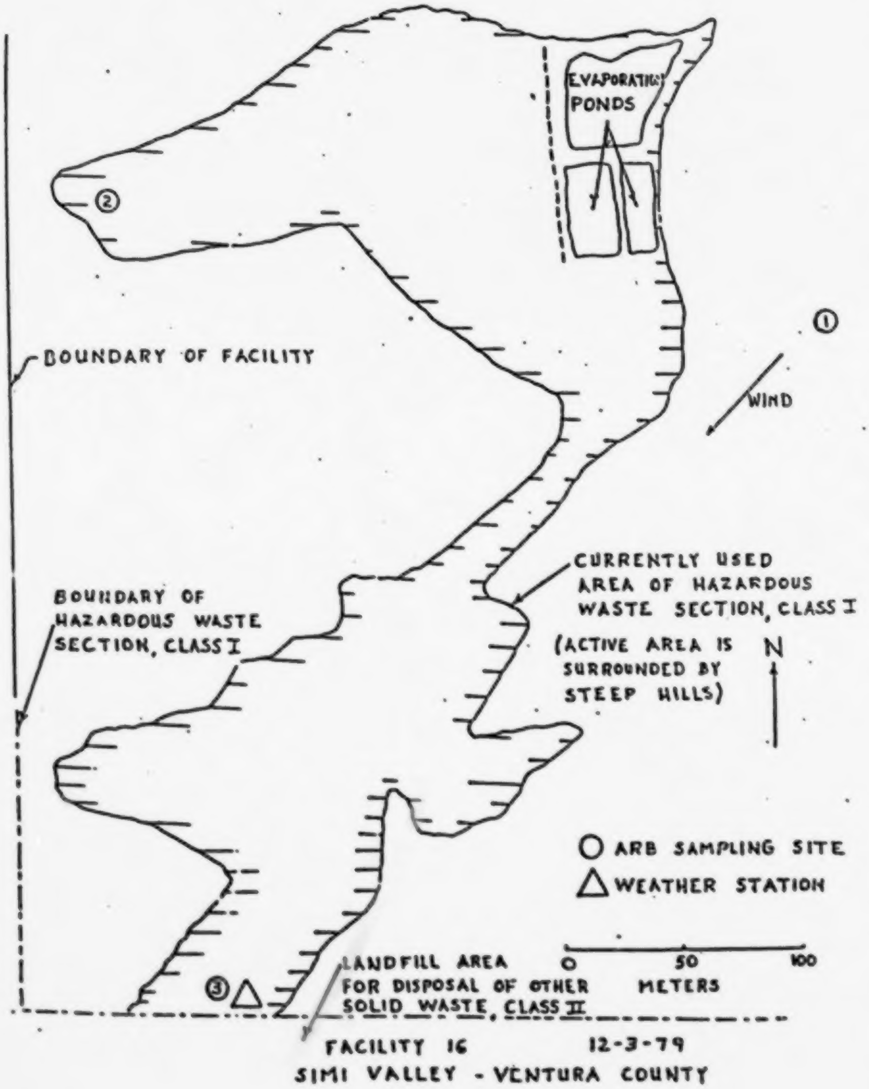

EVAPORATIO
PONDS
②
①
WIND
BOUNDARY OF FACILITY
CURRENTLY USED AREA OF HAZARDOUS WASTE SECTION, CLASS I
BOUNDARY OF HAZARDOUS WASTE SECTION, CLASS I
(ACTIVE AREA IS SURROUNDED BY STEEP HILLS)
N
○ ARB SAMPLING SITE
△ WEATHER STATION
0 50 100
METERS
③ △
LANDFILL AREA FOR DISPOSAL OF OTHER SOLID WASTE, CLASS II
FACILITY 16 12-3-79
SIMI VALLEY - VENTURA COUNTY

Figure F-5. Simi Valley Landfill.

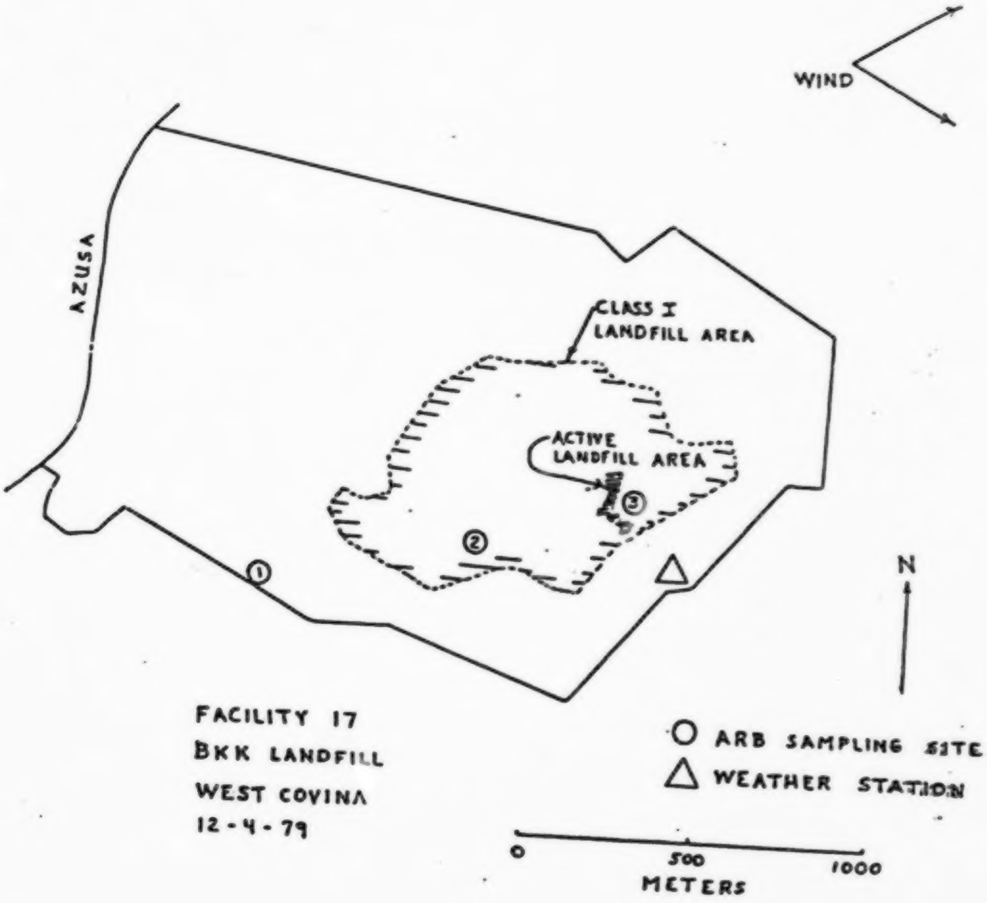

WIND
AZUSA
CLASS I LANDFILL AREA
ACTIVE LANDFILL AREA
①
②
③
N
FACILITY 17
BKK LANDFILL
WEST COVINA
12-4-79
○ ARB SAMPLING SITE
△ WEATHER STATION
0
500
1000
METERS

Figure F-6. BKK Landfill, West Covina.

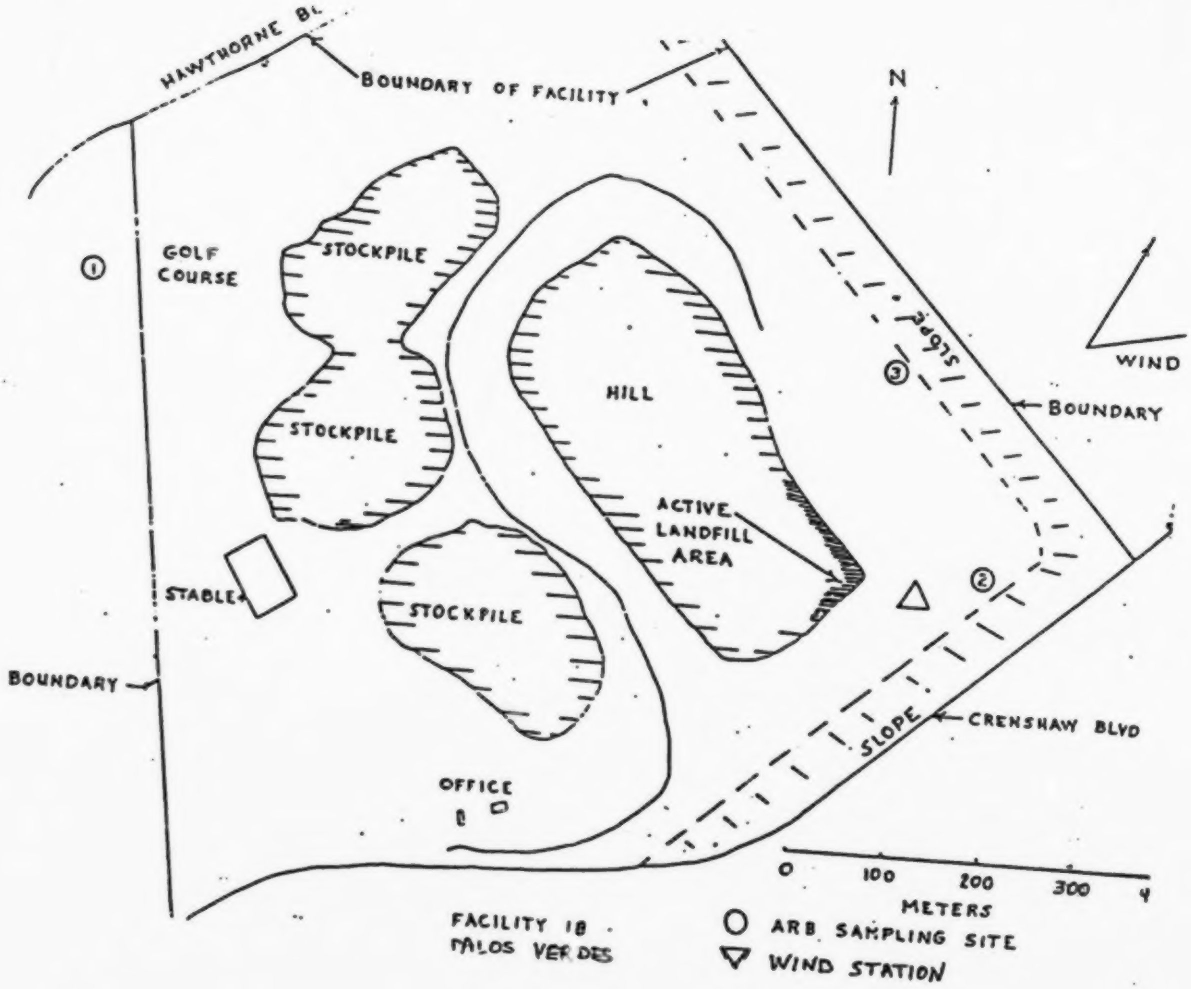

HAWTHORNE BL
BOUNDARY OF FACILITY
N
GOLF COURSE
①
STOCKPILE
STOCKPILE
STOCKPILE
HILL
ACTIVE LANDFILL AREA
SLOPE
SLOPE
③
②
WIND
BOUNDARY
BOUNDARY
STABLE
OFFICE
CRENSHAW BLVD
0
100
200
300
4
METERS
FACILITY 18
PALOS VERDES
O ARB SAMPLING SITE
▽ WIND STATION

Figure F-7. Palos Verdes Landfill.

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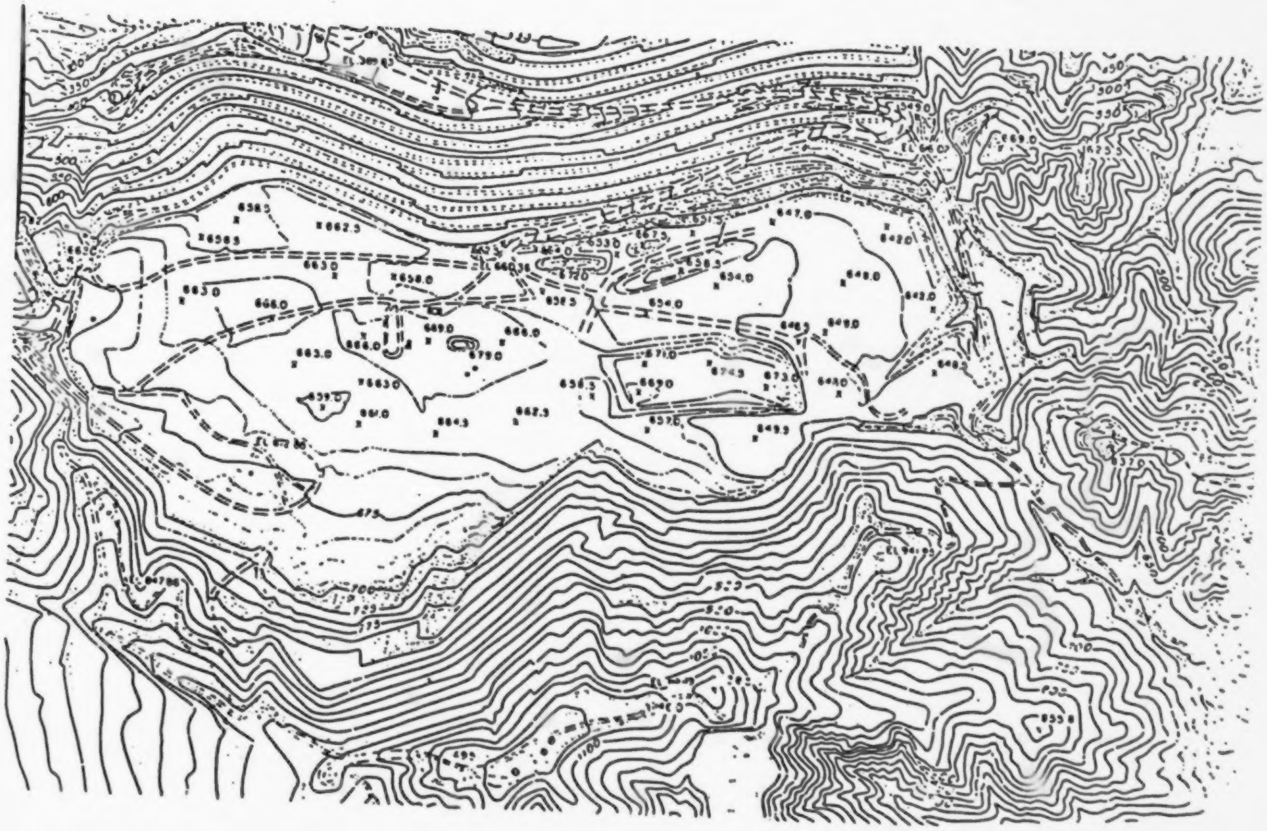

Figure F-8. Puente Hills Landfill.